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PRACTICAL PAINTERS' WORK

PAUL N. HASLUCK

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PRACTICAL PAINTERS' WORK

PREFACE.

PRACTICAL PAINTERS' WORK contains, in a form convenient for everyday use, a comprehensive digest of information, contributed by experienced craftsmen, scattered over the columns of BUILDING WORLD, one of the weekly journals it is my fortune to edit, and supplies concise information on the general principles and practice of the art on which it treats.

It may be said that the bulk of the matter contained in this book was contributed by Mr. William Fourniss, late examiner in painters' and decorators' work to the City Guilds of London Institute.

Readers who may desire additional information respecting special details of the matters dealt with in this book, of instructions on any building trade subjects, should address a question to the Editor of BUILDING WORLD, La Belle Sauvage, London, E.C., so that it may be answered in the columns of that journal.

P. N. HASLUCK.

La Belle Sauvage, London.
April, 1906.

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PRACTICAL PAINTERS' WORK.

CHAPTER I.

OBJECTS, PRINCIPLES, AND PROCESSES OF PAINTING.

THE covering of a large surface with an even and solid coat of paint is an interesting process, which, being carried on under widely varied conditions, calls for great skill and taste. It requires also much forethought to save needless expenditure of labour and material. How necessary it is, then, that a painter should have a clear understanding of the purpose of each step in each process, as well as of the temper and nature of the various materials employed.

To protect, cleanse, and embellish is the object of painting. Deleterious gases, acids in the atmosphere, water, variations in the temperature, affect the materials used in building construction. Paint, therefore, is used as a protection to those materials, and withstands the action of the influences that are destructive to their surfaces. But paint is itself affected by atmospherical influences, though usually to a less extent than the surfaces to which it is applied; it is affected also by chemical action of its own, and by the influence of light.

Gases in the air, such as sulphuretted hydrogen, ammonia, etc., are enemies to paint, therefore the pigments and vehicles chosen must be able to resist these destroying agents. The vehicles, such as oil, used for binding and applying the colour, are also useful in resisting moisture, which is so injurious that its presence in the substance painted, in the colour, or in the brushes when in use must be carefully guarded against.

Paint should be applied sparingly, and must consist of materials that blend without being mutually destructive, that protect efficiently the surface to whieh they are applied, and that present a solid and agreeable colour.

Paint should "bear out"—that is to say, should be

so made that an even solidity and quality of surface may be presented. The work must be of one regular quality, not glossy in one part and dull in another. Deadness must not be confused with flatness; natural deadness in paint implies bad or decayed material, but artificial deadness or flatness shows quality in the colour because of the binding beneath the flat finish. It is this binding which offers a solid resistance to the destructive forces before mentioned.

In re-painting old work, the first thing to be done is to remove all grease, damp, and dirt, and the next to repair bad places. If the work is in a fairly good condition, a good wash with water in which a piece of soda has been dissolved is sufficient—the more the grease and dirt the more the soda—but the solution must not be so strong as to remove the paint: 1 oz. of soda to 1 pint of water is about right. The hard outer surface of the paint should be removed with pumice-stone, to ensure the adhesion of the successive coats. For this work there will be required a double pot containing the dissolved soda, a pail of clean water, and a brush for each.

Faults in the groundwork, such as resinous and damp places, rough and uneven parts, and holes, stains, and anything likely to affect the after work, must be dealt with at the outset. A conscientious workman will do what he can to prevent the troubles with which he has to contend from recurring in the future. All parts have to be brought to an even surface with as little waste of labour and material as possible. The necessary preparatory work should be governed by knowledge of how the various materials will behave in given circumstances—a knowledge that can be obtained only by experience and by careful and intelligent observation.

The proportions of the materials used and the methods of setting about the work, depend on variable circumstances, such as the state of the weather, the character and condition of the surface to be painted, the nature of the materials, and the amount of money allowed for the work, the last-named condition regulating more particularly the number of coats of paint, while the ultimate finish depends also on the time allowed in preparation. Hence proportions and methods cannot be definitely stated once for all, but must vary with the local conditions.

The difficulties to be overcome in painting new woodwork are due chiefly to the presence of resin, knots, and damp, and to unevenness of surface. Even the marks of the plane, unless removed, will show in the finished painting. Successive coats of paint emphasise them, and varnish helps to bring them into relief. Every precaution must therefore be taken to overcome the resin and the knots, to remove moisture and keep it away, to cleanse the work from all dirt and grease, and to secure a level surface.

New work requires filling to make the surface level, and old work needs facing with putty. When the paint has accumulated on old woodwork, it must be burnt off.

The several steps in preparing for painting are knotting, priming, puttying or stopping, filling up, and glass-papering. These processes are described in detail in Chapter V., p. 70.

A coat of paint should never be applied till the one below is thoroughly dry, otherwise crinkling is likely to occur. It must be applied thinly, so that it can harden quickly. Too much paint is as bad as too little. In using the brush, the same amount of pressure should be exerted all over the work, otherwise there will be a want of uniformity in the appearance of the finished surface. The successive strokes of the brush should be made towards the already painted part; thus less paint is required, and time is saved. The tinting of the various coats is intended, first, to make patches similar in colour to the rest of the ground, and, secondly, to obtain the tint of the final coat. The several coats of colour will combine better if they are alternately oily and flat.

Absorption or suction should, in every case, be stopped. Water must be kept out of the paint; driers must only be used sparingly, and there should not be too much oil. It is useless attempting to paint in oil colour on a damp surface.

Part of the discoloration which takes place with white-lead is due to the action of the oil. Though turpentine is volatile, it helps to join the pigment and the oil, and an excess of oil will hasten and develop discoloration of paint; but this can be checked to some extent by the addition of some turpentine. This last also has a resinous

property, which makes paint hard and durable. Painters' lead is a very sensitive substance, easily decomposed; oil turns it brown, and exposure in time turns it yellow.

Driers are much too freely used in paint. Warmth, ventilation, and intervals of time between the coats will greatly aid the drying of paint. If, however, driers are used, it is well to select those of similar nature to the lead, such as litharge or sugar of lead, because they combine better. The interval to allow between coats greatly depends on the time the paint takes to dry, the amount of warm air that acts on it, and the quantity of driers in the paint. In ordinary circumstances, white-lead, when used with 3 parts of raw linseed oil to 1 part of turps, will dry without the addition of artificial driers. If more linseed oil is used than necessary for a pigment, driers must be employed; but they weaken the paint, the most permanent colour being that with which the smallest quantity of driers has been used.

The stopping ought to be smoothed before the second coat of colour is applied, and, as a rule, all roughness should be removed as soon as possible. The principal rubbing down, however, is after the second colour. In laying these coats of colour, the brush is held at right angles to the face of the work, which is thus touched by the end of the brush only. Care should be taken not to dip too deeply, and not to allow any colour to enter the stock of the brush. The colour must be spread evenly over the surface, crossed diagonally so that it lies even, and finished with a light touch up and down.

A few principles must be attended to when painting in oil colour. First, do not overload the surface with paint, which, if spread too thickly, will crack. The coat of colour must be mixed well, in order to penetrate and grip the ground below, and dry hard quickly. If too much colour is applied to metal surfaces it will flake off. A brush-mark or flaw in the first coat, unless removed, will show in the last coat, no matter how many coats are applied; each coat of colour on the top of a rough mark makes it more difficult to remove.

The work must be hard enough for pumicing, and care must be taken not to rub through the hard surface of the colour to the softer part underneath. Directly the work

grows soft under the pumice-stone, it must be allowed to harden before proceeding further. It is advisable not to pumice till all is thoroughly hard. Endeavour to work each coat of colour so as to make all similar in nature, equally elastic and equally dry, so that one coat will aid the others to acquire solidity of surface and colour.

The object of glasspapering is to make the work smooth by removing the surface roughness; inequalities of surface are best obliterated with pumice-stone. Glasspapering should not cause scratches; to produce a geometric pattern of such marks over the work is not the object Hold the glasspaper lightly, and rub the surface of the work with a circular motion; for woodstaining, the motion should be upwards and downwards. Although worn glasspaper does not cut so effectually as that which is new, it gives a better finish. Any raised grain, or any dirty mark in stained work, can be removed by means of glasspaper.

Work that has been well glasspapered has, at the finish, a better surface than can be otherwise obtained. Dirt is thus removed, also nibs and irregularities which no after-painting will conceal, and which varnishing only brings into relief. Careless glasspapering of a door may bring it into a condition that no after-work can rectify, producing unsightly scratches in all parts. Glasspapering, however, will remove surface roughness only; it will not level down.

In preparing colour, first mix a small portion to the required tint on a palette board, as a guide to making the rest. Begin by mixing the colour required in oil, and when the tint has been attained, add the thinnings, then strain all. If muslin is used, damp it with water first, but with wire strainers this precaution is not necessary. Wipe off the superfluous colour from the strainer with a palette knife, not with the sash-tool with which the colour has been gently pushed through the strainer. The sash-tool employed for this purpose should be rinsed out in turps and wiped on a rag before being placed in the strained colour.

To cover black, or any dark colour, which is to be left lighter at the finish, begin by giving a coat of red, orange red, venetian red, or burnt sienna; a cold colour will cover and look well over this preparation. If a medium colour is wanted, mix from the above a warm amber colour; over

this, green will cover in two coats. Leather colour, or any of the tones mixed with white and the ochres, siennas, or umbers, will then cover in one coat.

As a rule, the method to adopt in laying coats of colour is to alternate the coats—first coat oily, second coat flattish, and so on. The coats work and combine better in this way. In applying the first coat, an endeavour should be made to bring all the work to an even colour, no matter what that may be. The next thing is to begin a gradual approach to the colour required in the finishing coat.

Some workers adopt a system such as this: The second coat consists of one-third turps; the third, half turps and half oil; the fourth, one-third oil and two-thirds turps. When the second coat is dry and hard, it must be well rubbed down with glasspaper, and examined to see whether further stopping is needed. Whatever the colour be, it should have pureness of tone, brightness and depth, and body.

White-lead is used for giving body, though there are colours that have sufficient body of themselves without the addition of white-lead. Paint should also possess durability, which is greatly promoted by thorough incorporation of the materials. The second-coat colour is intended to level up not only the surface but also the colour; the next is to give solidity and to stop unequal suction. The final coats should give a finish that is level in surface and in colour. To obtain a good finish, some painters thin the second coat with one-third turpentine and two-thirds raw linseed oil. The second and third coats may be rounder, and the last coat thinner. The paint should be well rubbed out; it is a mistake to make paint too thick. Not a large quantity of paint, but solidity and levelness, should be the object. The third coat, mixed with half and half, and rather oily, can be tinted to something like the final colour desired, but neutral, and slightly darker.

The flattening comes last: it is used thin, with a full brush, and must be quickly laid off with a light touch, or stippled. A badger-hair softener is better for doors than the ordinary hog-hair stippler, as it produces finer stippling; or it may be used for laying off the colour. A bastard flat, or eggshell gloss, is sometimes used as a finish, because it wears better than a flat. A bastard flat

may be made of one-third oil and two-thirds turpentine, and may be improved by the addition of wax. Shred white wax into a clean gallipot; stand the gallipot in a saucepan, or any iron receptacle, and surround it with water; subject it to moderate heat till the wax is melted, and then add to the paint. Half an ounce of this melted wax is sufficient for 1 pt. of colour. In melting the wax, care must be taken not to let flame get to it, as it is very inflammable. Half a teaspoonful of varnish, as well as the wax, should be added to the flat. When two coats of oil colour are specified, defects must be remedied, the work stopped, and the surface given a turpentine second colour and finishing oil coat. Second colour, when mixed flat, must contain a certain quantity of oil, in the proportion, say, of 3 parts turps to 1 part raw linseed oil; ½ part of japanners' gold-size would improve the colour. Driers should be used in a small quantity, regulated by the circumstances.

For new work, oil second colour is sometimes employed with less turpentine and more oil, according to the state of the ground, and 1½ oz. of driers is then used to about 10 lb. of lead. For old work, turps second colour is required, 3 parts turps to 1 part oil. In both new work and old, flat second colour is adopted when the work is to be finished in two coats of oil colour. The oil ground-coat has a better gloss when put on a flat ground.

For four coats and a flat, the first coat should be nearly all oil, mixed very thin, and be allowed three or four days to dry; the second coat should be two-thirds raw linseed oil and one-third trupentine; the next coat, two-thirds turpentine and one-third linseed oil; whilst the fourth coat is nearly all linseed oil. The flat finishing-coat should be made up of turps with a little oil or varnish to bind it. Each coat should be thoroughly dry, except the last or oil ground for the flatting. The flatting should be done while the ground is soft, to enable it to sink in. The ground is usually laid one day and the flatting the next.

In two coats and flat, the first coat is similar to the turpentine second colour described above, and the actual second coat or ground is an oil coat, the finish being a flat.

To mix flatting, bind it with a teaspoonful of either oil or varnish (encaustic- or wax-varnish is preferable) per

half-gallon of colour. Mix it the day before use, as the turps will then be less likely to lift the ground, which, for flatting, should be an oil, comparatively soft, darker, and more neutral than the flat, so that the flat may sink in and combine with the oil coat. The ground for flatting may consist principally of oil colour, a small quantity of turps being employed to give it fluidity and make it settle down better.

When work is finished in oil colour with a gloss, it is usual to mix a little turps with it to harden the surface. Oil is the life of paint, but turps makes the ingredients mix better, prevents the colour running, and helps hardening. When four coats are specified, to be finished in oil, it means, second-colour oil, third-colour turps, fourth-colour oil finish.

Distemper (water colour bound with size) requires to be laid on by short strokes in all directions, which is best done with a two-knot brush. When the unequal suction of the ground is corrected by clearcole, one coat of distemper is all that is needed; but a second coat requires that the first one should be sized down to bind it; a double coat, however, is seldom satisfactory.

Special precautions must be taken by the painter to avoid lead-poisoning. Care should be taken to wash the hands frequently in a strong decoction of oak bark. A painter should keep his hair and beard short, and wear a cap while at work. He should always wear a blouse and overalls when at work, so that he can remove the paint when not at work. Before eating he should rinse his mouth with cold water. He should eat fat and drink milk. Acidulated drinks are beneficial, but spirits are injurious. Citric acid or acetic acid (vinegar) in water is a good drink. Drinks made from lemons counteract the effect of lead. A small portion of salad oil the last thing at night, as much as can be digested, should be taken, when using lead. He should at once consult a doctor if he finds that his bowels are not acting properly, or if he has pains in the inside.

CHAPTER II.

PAINTERS' TOOLS AND APPLIANCES.

The paint shop should be on the ground floor, and should be large—say 24 ft. by 14 ft.—well lighted from the north, with proper provision for artificial lighting; it must be dry, dustproof, and provided with a well-guarded fireplace or shut-in stove capable of heating a 3-gal. bucket; it must also possess a water supply with sink and waste. The walls, whether of board or brick, should be painted white to assist the light.

The shop should be furnished with mixing benches, having drawers in which to keep cotton waste, rags, tools, etc.; and with paint stones (slabs of flawless marble about 2 ft. square and 1½ in. thick), a muller for grinding, palette knives, straining muslin, shears, corkscrew, cask-opener, case-opener, and pumice-stone. The shop should be fitted with such shelves and cupboards as may be required, and with bins to hold whiting, plaster, etc.

Other requirements or conveniences are—scales and weighing machine, paint mill, large oil tank with taps, a pickle tub containing a potash solution in which to clean pots and pans, smudge and refuse kegs, a large flour barrel, spouting cans for mixing paints, smutch cans for cleaning brushes, baskets, etc. Small paint mills, for grinding the pigment to a very fine powder for the use of coachbuilders and decorators, are now so cheap (ranging in price from £2 to £10) that they are no longer regarded as a luxury, but as a regular adjunct to the plant of every well-equipped paint shop.

The painting room, which should be similar in shape to the paint shop, but larger, should contain portable benches formed of three-legged trestles and boards, as well as a fixed bench well supplied with drawers; paint slab, muller and knives, sign-writer's easels, shelves, cupboards, and a heating stove. In the store room, which should adjoin the paint shop, small articles, such as sash tools, stencil

tools, sponges, and leathers, may be kept in drawers; brushes, dusters, limers, and distemper brushes should, together with new cans, kettles, and buckets, be hung from galvanised hooks fixed in the ceiling.

Ladders of various lengths are required, those most generally used being from twenty-four to forty rounds long; whilst the handiest sizes of trestles or hinged double ladders are from 8 ft. to 10 ft. "Steps" also are necessary. Window or gallows brackets, otherwise known as portable balconies (Figs. 1 and 2) are useful. In Figs. 1 and 2, C is the abutment piece which goes close to the outside wall, D the position of a piece of packing placed on

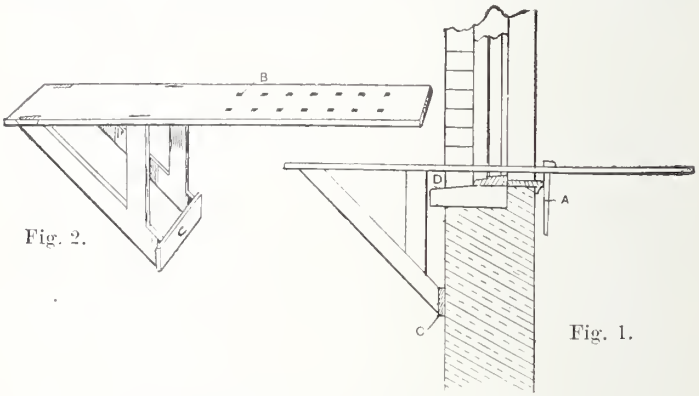


Fig. 2. Fig. 1.

Figs. 1 and 2.—Window or Gallows Bracket.

the sill, and A two pins put through the most convenient of the holes B. This was formerly a much used arrangement, but it is not so safe as it should be.

The travelling cradle patented by Mr. Edwin Palmer is now in general use for enabling workmen to be raised or lowered to places to which it would be inconvenient or impossible to fix ladders, or where excessively long ladders would be required, or, again, where the large surface to be dealt with would necessitate continual shifting of the ladder. The Palmer light cradle or boat is raised and lowered by means of the ordinary tackle, the headblocks of which run along a wire rope or cable, by the aid of guy lines, carrying the cradle to any part of the structure

where its presence is desired, the shifting of position being carried out by the occupant of the cradle without assistance. The cradle is about one-eighth of the weight of an ordinary 20-ft. boat, and will reach twice as far. It can be used not only wherever cradle work is practicable, but

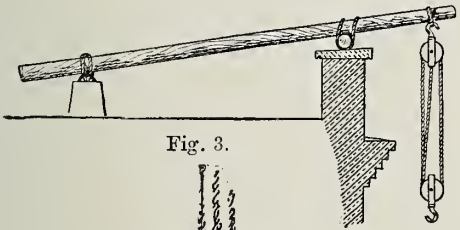
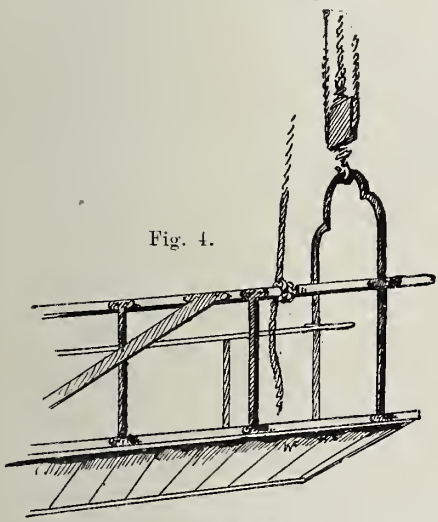


Fig. 3.

Fig. 4.



Figs. 3 and 4.—Painter's Boat.

in many cases in which ordinary cradles or ladders would be impossible. The wire head-rope is tested up to 8 tons, whilst its usual burden with two men in it is less than 4 cwt. The apparatus is equally well adapted for inside and outside work.

The ordinary painter's boat (largely superseded by the Palmer cradle described above) is rather dangerous, but is still frequently used. It is quite independent of the pave-

ment, but great care is needed in its management. To support it, a few slates may be removed, and the stays of the boat securely screwed and fastened to the rafters of the roof; if this is not done, heavy weights and a long leverage must be used (see Fig. 3). The boat should be worked from the roof, and double sheave-blocks should be employed (see Figs. 4 and 5). A labourer should be stationed at each rope, in order to raise and lower the

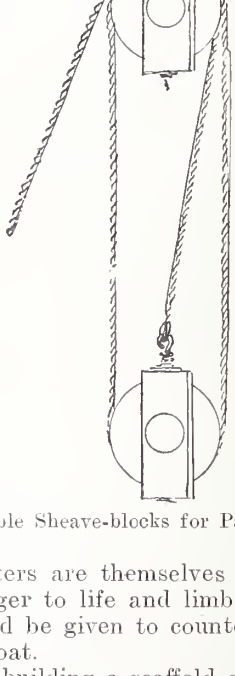


Fig. 5.—Double Sheave-blocks for Painter's Boat.

boat. If the painters are themselves allowed to lift the boat, there is danger to life and limb. Sufficient weight and leverage should be given to counteract the weight of the men and the boat.

Another way of building a scaffold on a stucco front is by means of cross poles and struts from the windows, but in this case the tubs of earth to hold the upright poles on the pavement would cause much annoyance in a crowded thoroughfare.

Dust-cloths or drop sheets, of coarse unbleached stuff, in 5 yd. lengths, $2\frac{1}{2}$ yd. wide; narrower cloths (say 1 yd. wide) for stairs and passages, and small (1 yd. by $1\frac{1}{2}$ yd.) cloth for the protection of fittings, etc., with others of sufficiently varied sizes to meet all contingencies, should be plentifully stocked. They should be of sufficiently close texture to be drop-proof, and should always be tidy, in order to inspire confidence in the householder and his lady, who are naturally anxious for the protection of their belongings.

The trade catalogues contain clearly illustrated descriptions of the articles necessary to the painter's plant, such as pails or buckets for distemper, washing off, etc.; galvanised or tinned paint kettles (ranging in diameter from 41 in. = 1 pt. to 9 in. = 10 pt.); thumb pots of glazed ware or zinc for distemper, etc.; stock drums or kegs, portable

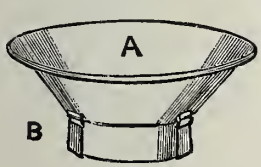


Fig. 6.

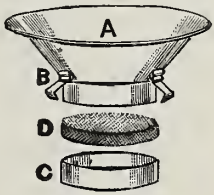


Fig. 7.

Figs. 6 and 7.—Paint Strainer and its Parts.

pinewood mixing boards ($\frac{3}{4}$ in. thick and 12 in. by 9 in., or 15 in. by 10 in.); graining and marbling tools, chamois leathers, etc.

The best method of cleaning paint and varnish cans and bottles is to place $\frac{1}{2}$ lb. of caustic soda with 10 gal. of water in a copper or other suitable vessel, and heat the water until the soda is dissolved. Fill the bottles, and allow them to sink to the bottom of the copper, then on these place the paint cans; cover with a suitable lid, and boil for about fifty minutes. They should then be taken out and washed in cold water, when all traces of the paint and varnish will disappear. This method is adopted in paint and varnish works where steam instead of fire is used for boiling. Old paintpots are commonly burnt out, but the greatest care is necessary.

Paint strainers of various patterns are available. In

the form shown by Fig. 6, the metal body A (Fig. 7) has an easily replaceable copper wire gauze strainer D, this being held in place by the compression band C and the clips B. The strainer shown in Fig. 8 is made by C. H. Davis & Co., of Birmingham; the actual strainer is of muslin or coarse cloth, and is supported by a perforated plate contained in the hinged band. This is a good pattern for use in working paint through with a brush. The simplest of all strainers is the box (Fig. 9), 12 in. square by 4 in. deep, having a piece of coarse canvas secured to it with string or tacks in the manner shown.

Blow-lamps, burning-off, brazing, or spirit lamps, for removing old paint, are of very various patterns, which will be found fully illustrated in the trade catalogues. Charcoal braziers are still in favour where very large flat surfaces are to be dealt with.

Brushes are the most important tools used by the painter. A badly selected, badly used, and uncared-for brush will, even in skilled hands, prevent good work. The best brush for general house painting is made entirely of the best hog bristles. Bristles vary in quality, and are carefully selected for particular kinds of brushes. Cheaper materials, such as the hair of various animals (particularly horsehair), and various fibres, have been tried, either to adulterate or to supersede the wild-hog-bristle brush, but such substitutes, though cheaper at first, are found to cause loss of time, waste of material, rapid wear, and bad work. The longer the bristles, the more expensive are the brushes, but short bristles wear into stumps much more quickly. Cheap brushes have softer bristles. The best bristles for brushmaking are from the stiff and long hairs of the wild hog, and are obtained chiefly from Poland, Germany, Siberia, and Russia, but some are imported from China and Japan. The bristles in the domestic hog are not serviceable for brushes, being, as a rule, too short and lacking elasticity.

When choosing a brush, pinch the hairs between the thumb and fingers to ascertain whether it is scant of hair at the heart; if it is lacking in this respect it will feel empty. Then press the hair out level, and notice whether it has a good chisel-edge. See that all the hairs are straight and equal in length. To detect fibre, take a

small number of hairs, bend them over, and suddenly release them. If the bristles are good, they will quickly fly back to their original position, but fibre will remain more or less bent. But the only sure test of the quality of a brush is in the use of it, and it is wise to buy only of a good maker. Brushes should have a perfectly square bevelled edge; and the greatest care should be taken of these edges.

Of hog-hair brushes the pound brush is perhaps the most useful; it can be had in several sizes and shapes—round, oval, or flattened at the sides.

The hairs of a brush taper and incline naturally; that is to say, they fall over, and are not perfectly straight. In making the brush, the hairs are selected and arranged so as to incline together. It is therefore very necessary,

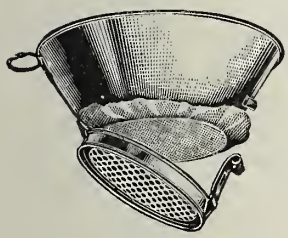


Fig. 8.—Davis's Paint Strainer.

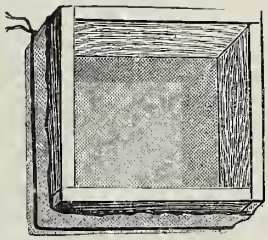


Fig. 9.—Square Strainer or Sieve.

in using, washing, and storing brushes, not to interfere with this arrangement, or the brush will be spoilt. They should always be stroked from the stock towards the ends of the brush, and never violently rubbed on a flat surface to get the paint out of the heart of the brush. It would be better to use a powerful solvent such as paraffin or benzine.

Brushes should not stand on the bottom of the can on their edge even for a few minutes; they should be suspended with their edges about an inch from the bottom. Brushes, especially varnish brushes, are best kept in an air-tight tin box; if kept in varnish they should not be deeply immersed. A hole bored in the handle, through which a wire is passed, will serve to keep the brush suspended in the liquid (see Fig. 10).

A new brush sometimes sheds its bristles. If the brush is gently knocked against the edge of a board, or brushed against a rough board, any loose bristles which have been insecurely fastened in the manufacture of the brush will come out; but, of course, the knocking will not prevent a bad brush from coming to pieces. A brush, even when new, is apt to be dirty from storage. Before use it should be washed, tried, and then well shaken and manipulated in the paint; or, when varnish is to be used, the brush should be worked in a portion of the varnish and scraped out with the palette knife until no specks are to be seen.

To tie up a brush, take a piece of strong stout string, hold it with the thumb against the stock of the brush,

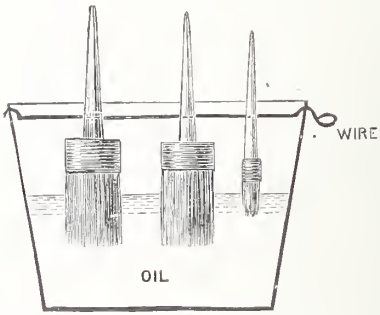


Fig. 10.—Suspending Brushes in Oil.

leaving about 7 in. loose at one end of the string, bring the other end round the brush, and tie the first round of cord near the stock. The 7-in. end may now be made to lie along the fibres of the brush, and the other end may be wound round again and again as high as it is required to go. Then the twine that has been laid along the fibre and round it should be bent back and tucked into the stock and drawn tight, and a half-knot made opposite the first one. Both ends of the string may now be tacked to the handle of the brush, and the extra string cut off. Care must be taken not to pull the string too tight, for when any moisture gets to the hairs the brush will swell; and the thickness of the string should correspond to the size of the brush.

Another way to tie up a brush to be used in paint is as follows: Double the string, holding the loop thus made with the left-hand thumb. Then bind the string round and round the bristles as high as needed, and pass the right-hand string through the loop, and pull the loop down behind the string which has already been wound round the bristles. They can then be tied together, and no further fastening is needed; but the string tied in this way is liable to slip. Still another way to tie up a brush is first to tie one round of the string (Fig. 11), leaving about 7 in. lying along the hairs (A, Fig. 12). Now wind up the string B round the bristles as high as desired. Then double the winding string B back to form a loop (Fig. 13) on the opposite side of the brush to the string A lying along

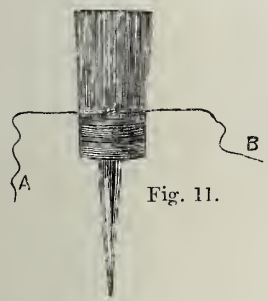


Fig. 11.

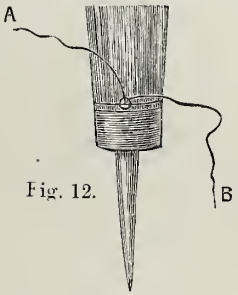


Fig. 12.

Figs. 11 and 12.—Tying up Paint Brush.

the hairs. Slip the end of the winding string B through the loop (Fig. 13) forming the knot (Fig. 14), and, pulling both strings down the stock to the handle, fasten them to the stock of the brush with small brass-headed nails or tacks; then cut away the excess of string.

Every painter likes to "wear in" his own brushes; he thus gets used to certain brushes, and the brushes become adapted to his method of using them. Each man should have a locker in the paint shop in which to keep his brushes when not in use. When the man is engaged, he should give a receipt for his kit of tools, the receipt to be returned to him on his discharge. All the brushes should be so marked that if one should be missing the fact could be at once reported. It is usual on large jobs for the

foreman or his assistant to take charge of the brushes at night and give them out each morning. Each man then gets his own brush, and as they are all tallied there can be no dispute.

Brushes should not be kept in a hot place such as near steam pipes or stoves, because the handles are liable to shrink and the hairs to come out. A damp place is just as objectionable, although, if the handle of a brush has shrunk from having been kept in a hot place, to keep it in a damp place for a while may perhaps restore it.

Varnish brushes should not be kept in water, especially those set in glue and string. They should be kept in oil or varnish, and in an air-tight box. Even when they are

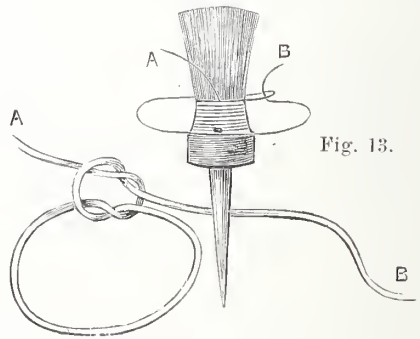


Fig. 13.

Fig. 14.

Figs. 13 and 14.—Tying up Paint Brush.

kept in varnish, the varnish is apt to dry in the stock, and afterwards to break away, when the brush is in use, and make the varnish gritty. When a varnish brush is kept in oil, care should be taken to let the oil be a little way over the stock, but the oil must be thoroughly scraped out before putting the brush in varnish. A rinse in turpentine may be given, and a little time should be allowed before using the brush, so that the oil and the turps shall not get into the varnish.

Some painters keep their brushes in a mixture of 3 parts raw oil to 1 part turpentine. But turpentine makes the bristles harsh, and divides the hairs so that they will not lie together. All brushes absorb moisture. It is cus-

tomary to put new brushes in water over-night in order to swell the hairs, and so prevent them from coming out; they ought to be quite dry before use. If water is in the hair when the brush is put in the paint, it will prove injurious. Another objection is that the water weakens the bristles. It is far better to soak brushes in oil. Brushes after being used for japan black should be kept in raw linseed oil, should be occasionally rinsed in paraffin, and finally be washed out in warm but not hot water.

When ordinary paint brushes are kept too long in either oil or water, the bristles are apt to lose their spring. They are also liable to the danger of the paint or varnish drying in the stock of the brush on account of evaporation. They should occasionally be washed in turpentine or paraffin, and then given a slight rinse in either of these solvents, and a finishing wash in soap-and-water, being finally allowed to dry before being brought into use again.

When string-bound brushes are kept in water, the string easily rots. To prevent this, give the string a couple of coats of knotting or resin varnish before using the brushes.

Let the brushes lie in oil to soften the hairs, and wash them out occasionally, so that they may not get too soft. Brushes are injured and destroyed by frequent use in hot alkaline solutions, hot soda water, and hot lime-wash. They are also injured by damp. Portions of colour, and even size, paste, or stale beer, rot brushes, so that in all cases a frequent thorough washing is necessary to keep them in good condition. If, from being left in a dry condition for too long a time, or from being stored in too hot a place, the hairs of the brush get loose, drive a small wooden wedge between the handle and the bristles; this will effectually tighten them. If a brush has got hard in the paint, soak it in paraffin oil till the paint is softened, and finish by cleaning with soap-and-water; a very little soda may also be used.

There is no better way to clean a brush than to dip it into turpentine contained in a clean pot, and scrape the colour out with a knife, repeating this until the paint is all cleaned out of the brush. Soap-and-water will complete the cleaning. Although soft-haired brushes are sometimes kept in oil, they should not be left in it too

long, as the oil has a tendency to weaken the hair; and they should not be cleansed with soda. If such brushes are left out of colour too long, they get harsh; if left too long in oil, they get too soft. Alternate treatment keeps them in a good condition.

Camel-hair and sable brushes, as well as the various substitutes for sable that are used by painters, are

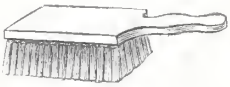


Fig. 15.

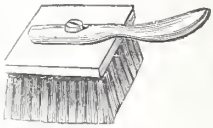


Fig. 16.

Fig. 17.

Figs. 15 to 17.—Stipplers.

cleansed in paraffin oil or turpentine. They are never left in the paint, but sometimes are kept over-night in a flat dish and covered with oil. If they are kept for a long time unused, work some tallow into the hairs after washing them out; when the brushes are wanted for use the tallow must be well washed out with spirits.

All brushes should be kept in a cool, dry, airy place, and should always be put away moderately dry. Moths should be guarded against, because they lay their eggs in the ends of the hair; the eggs can be removed by

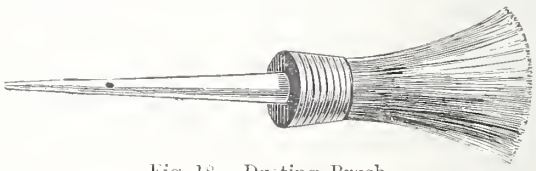


Fig. 18.—Dusting Brush.

brushing them away, but the moth can be kept away altogether by the use of camphor, insect powder, or naphthalene.

Old brushes of all sorts are always useful as scrubs. For limewhiting, use fibre brushes, and immediately after use, rinse out all the lime from the brush, as otherwise it burns the fibre.

Every brush is the better for a metal ferrule, fastened with a catch or nails. These resist the action of water and spirit. Should any hairs be turned at the point, they can be straightened by dipping them into boiling water quite

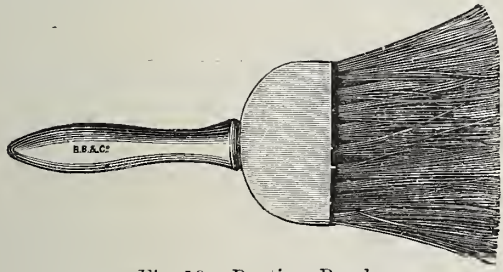


Fig. 19.—Dusting Brush.

straight up and down. Ironing them with a hot iron is sometimes effectual.

Small brushes should not be used to do work which a larger brush will do. Small economies at first mean a great saving at the finish.

Stipplers must be thoroughly washed in soap and warm water immediately after use, as also should badger-hair brushes, used for levelling paint and for fine stippling. The stipplers should be washed without wetting the wood, for fear of warping it, and should be finally rinsed with water and beaten on a dry cloth to remove the moisture. Stipplers (see Figs. 15 to 17) are used effectively for removing any brush marks that may occur in painting, and

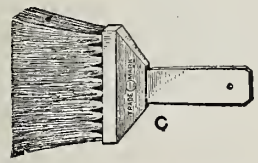


Fig. 20.—Dusting Brush.

to ensure a level, even coat of colour. They have a perfectly flat and regular surface of hair, and produce an evenness of colour not otherwise obtainable. A well-laid coat of paint does not require a stippler, but it is necessary for

large flanks of thin flatting colour on walls, and it is of value even in distempering. The shape of handle used is a matter of individual choice. The hairs of a stippler should be kept perfectly straight, and only a light sharp tap given in using it; never strike it so hard as to bend the hairs.

Fig. 21.—One-knot Ground Brush.

The brushes known as dusters (see Figs. 18 to 20) are made so that the hairs spread out, and cannot be used for painting. A worn-down duster should be thoroughly washed out, and will then do for rough work; but it is not suitable for special work, as a certain amount of dust and dirt always gets into the stock, impairing the elasticity of the brush. In every case the stock of the brush should be kept clean, or it will lose its spring, and the dirt, too, is liable to work down into the paint. The hairs of a dusting brush are apt to fall out either through the shrinkage of the hairs or by the perishing of the cement which originally bound the hairs together. To repair it, remove the ferrule and handle, and replace the hair which has come away, putting the butt ends of the hair together, then dipping the end in hot pitch or glue to the depth of $\frac{1}{2}$ in., allowing the binding substance to enter between the

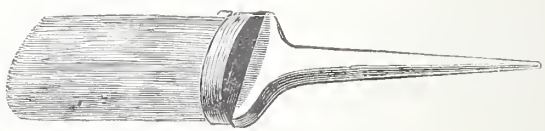


Fig. 22.—One-knot Ground Brush.

hair ends. Then take a piece of thin wire about 1 ft. long, tie up the bunch of hair at the base, and dip it again in the hot binding pitch or glue. Now fasten on the ferrule, and then drive in the wedge end of the brush handle, using a vice for this operation. Finally force in the round piece of wood which serves as a base to the hairs.

One-knot ground brushes (see Figs. 21 and 22) if used in varnish or as dusters, soon become loose in the hair. Some painters use them as dusters to soften them for use in paint; but this practice is not recommended, as it tends to break and loosen the hair. Ordinary one-knot ground

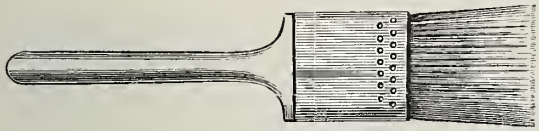


Fig. 23.—Flat Varnish Brush.

brushes are often used for varnish, for which, however, they are unsuitable; there is a special quality for that purpose.

Flat varnish brushes (Figs. 23 and 24), made in metal cases, are mostly cemented with glue, and therefore should not be soaked in water before use. If properly

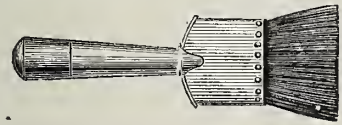


Fig. 24.—Flat Varnish Brush Brush.

made, they can be used at once. Flat brushes are suitable for panels and stiles; and round brushes (Fig. 25) for broad spaces and general varnishing. Ordinary pound brushes taken for varnishing should first be used in paint. Proper varnish brushes are made more carefully, and have finer hairs than those made for ordinary painting. Large

Fig. 25.—Round Varnish Brush.

brushes made from camel-hair, badger-hair, bear-hair, and goat-hair are in some cases as satisfactory as hog-hair brushes for varnishing.

The large long-haired springing distemper brushes require specially careful treatment. They should always be

thoroughly washed out after use, as the distemper affects the hair. A little soap and hot water is necessary to wash out Duresco. After washing, the hairs should be straightened by putting the brushes against each other and against the palm of the hand. The hairs can then be laid carefully

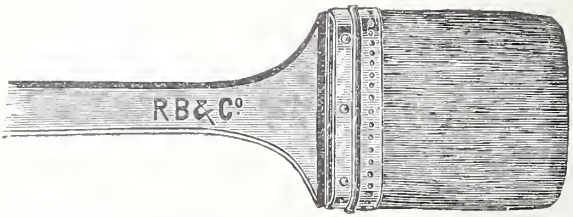


Fig. 26.—Distemper Brush with Copper Band.

on top of each other. Then place the brushes where the hair is not likely to be disturbed; but they should be put into water occasionally, lest they get too dry.

Distemper brushes must not be used for scrubbing off old distemper; only a worn-out brush, or a fibre brush, should be employed for such rough work.

In a wire stock distemper brush the bristles will be found sometimes to get loose. Before use, the bristles are held tight against the stock by the wire. When soaked and in use, the bristles and wood, being porous, swell with water and push the wire out. Then, when the brush gets dry or partly dry again, the great quantity of moisture

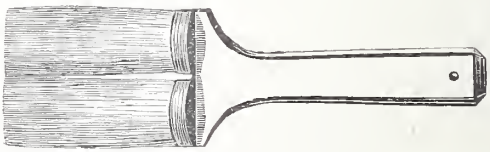


Fig. 27.—Distemper Brush with Wire Stock.

absorbed by the wood and the bristles evaporates, the bristles contract and the wire does not, and so the bristles get loose. Copper-bound and tin-bound distemper brushes, which are not subject to this failing, are obtainable (see Figs. 26 to 28).

Brushes used for stencilling are generally of hog-hair, and are made in great variety. They should be cleansed in the same way as those mentioned above. They are apt to get knocked up in the centre, so that the face of the brush, instead of being level, becomes concave. A

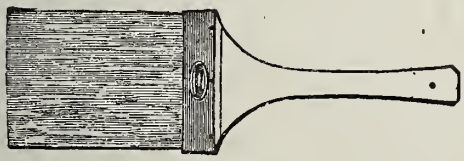


Fig. 28.—Flat Distemper Brush with Copper Band.

good stencil brush can be made by tying up a sash-tool to the short length necessary for stencilling; such a tool is less liable to knock up.

Grainers' tools (fully illustrated in the companion volume, "Practical Graining and Marbling") should be always washed after use, and dried in order to avoid mildew, which occurs from keeping damp brushes lying close together in a basket or bag, so that the air does not circulate through them.

The great variety of smaller brushes in use—sash-tools (Fig. 29), running from No. 1 to No. 12, fitches of all sizes, flat and round—require the same careful treatment as the larger brushes. Take care not to remove the hairs from their proper direction, either in use or in cleaning. There are bevel-edged sash-tools and flat fitches for all purposes. A very useful tool for painting sashes is a flat

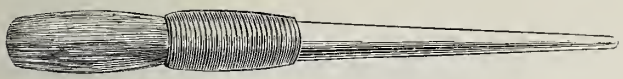


Fig. 29.—String-bound Sash Tool.

brush, with its hair cut on a slant similar to French lining fitches. A well-worn flat fitch will often make an excellent brush for running lines.

A well-made camel-hair brush is often as good as a black sable. Ox-hair and lion-hair brushes are sold as

being cheaper and stronger than camel-hair, but nothing has the strength and spring of a red sable.

A great variety of small brushes useful to the decorator are, although made in metal as well as quill, called from the name of the quill. They consist of the miniature, the crowquill (Fig. 30), the duck (Fig. 31), the goose (Fig. 32), the full goose, the extra-full goose, the small swan (Fig. 33), middle swan and large swan. Besides these, there are the short-haired brushes used for ornamental painting. Then there are the various sizes of writers' brushes, which are long in the hair; and, lastly, the overgraining brushes and the brushes used for marbling. It is unnecessary to give particulars of every brush employed

Fig. 30.—Crow Quill.

Fig. 31.—Duck.

Fig. 32.—Goose.

Fig. 33.—Swan.

in painting; space being so valuable here, it has been thought better to refer readers to the many trade catalogues for illustrations of the great variety of brushes in use.

Several knives are necessary. The palette knife (Fig. 34), which is long, flexible, blunt, and round at the top, is used for rubbing up colour on the painter's palette; the flat part spreads and rubs and mixes the colour, whilst the long thin blunt edge scrapes the colour together. In using this knife, it is well to remember that the quickest way to mix colour is to do a small portion at a time, as a large quantity is more likely to be imperfectly mixed.

A piece of stout glass is very handy for mixing colour

on. Colour is now so perfectly ground at the mill that it very seldom requires grinding on a stone or muller.

A painter's palette board, from which it is easy to scrape off the colour into the pot, is made in the same

Fig. 34.—Palette Knife.

way as a putty board, but is larger. A handy size is 1 ft. by 10 in., the handle being 8 in. long.

The stopping knife (Fig. 35) is a strong knife, shaped like an Indian spear. It is slightly flexible at the edge, so as to enable the workman to press the putty well into the holes to be stopped, and yet is stiff enough to level the putty to the surrounding surface.

Fig. 35.—Stopping Knife.

The chisel knife (Fig. 36) is made in various sizes, varying from 2 in. to 8 in. across the edge. It is useful for laying on the filling-up stuff, for stripping paper from the walls, and for all kinds of levelling.

The knives should always be kept clean, and wiped immediately after using. The paint should not be allowed to accumulate about the handles. Always, therefore, have handy a piece of rag to wipe away the paint while still wet.

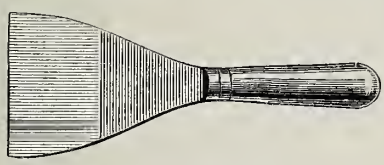


Fig. 36.—Chisel Knife.

A pocket knife, too, is very useful for cleaning out quirks in remote places, which are inaccessible to a larger knife.

A hacking knife, leather-bound in the handle, is very useful; no other knife will do as well, and no makeshift is economical.

A valuable auxiliary to the painter's outfit is the aerograph spray painter, which ejects the paint as a spray produced by means of compressed air. The colour is easily deposited on surfaces that would either be damaged by or would resist the action of brush-work. The rapidity of its action is only limited by the power of the operator to shape and develop his design; because the most rugged and intractable surface cannot offer the slightest opposition to the action of the aerograph, whereas the painter wastes time, and is forced to abandon many promising artistic conceptions as impracticable, because of the intractability of surfaces, and because of the friction inseparable from the use of the brush. Another advantage is the delicate gradation of tone that can be secured. The emission of the colour can be controlled with the utmost nicety by means of a valve regulated by the finger of the operator, who can thus at will produce close, open, or most delicately graduated shading or tinting, granulated or solid. Stencilling can be done by means of the aerograph much more rapidly, and with far more artistic results, than with the stencil brush. Embossed wall hangings offer excellent opportunities for the use of the aerograph, and gold and silver enrichments can be applied through the medium of this instrument with as much ease as ordinary colours. The instrument for small work is of about the same size, and presents much the same appearance, as an ordinary stylographic pen. The compressed air is supplied from a pump worked by the operator's foot. The handpiece for larger work, such as mural decoration on a bold scale, or distemper washes, is larger, and of the shape shown in Fig. 37, which is about one-fourth full size. It is fed by a wheel hand-pump of 3-in. diameter and having a 7-in. stroke, the whole apparatus weighing about 125 lb. A flexible tube for compressed air connects with the nipple A. The finger lever F controls both the air valve and a paint valve in the nozzle at N, so that little or much paint may be allowed to pass out into the current of escaping air. The paint may be supplied, under pressure, through a flexible tube from a large paint-pot,

passing through the tube P to the nozzle N, or it may be supplied in smaller quantities from a cup (Fig. 38), which is attachable at B, and when so attached cuts off the

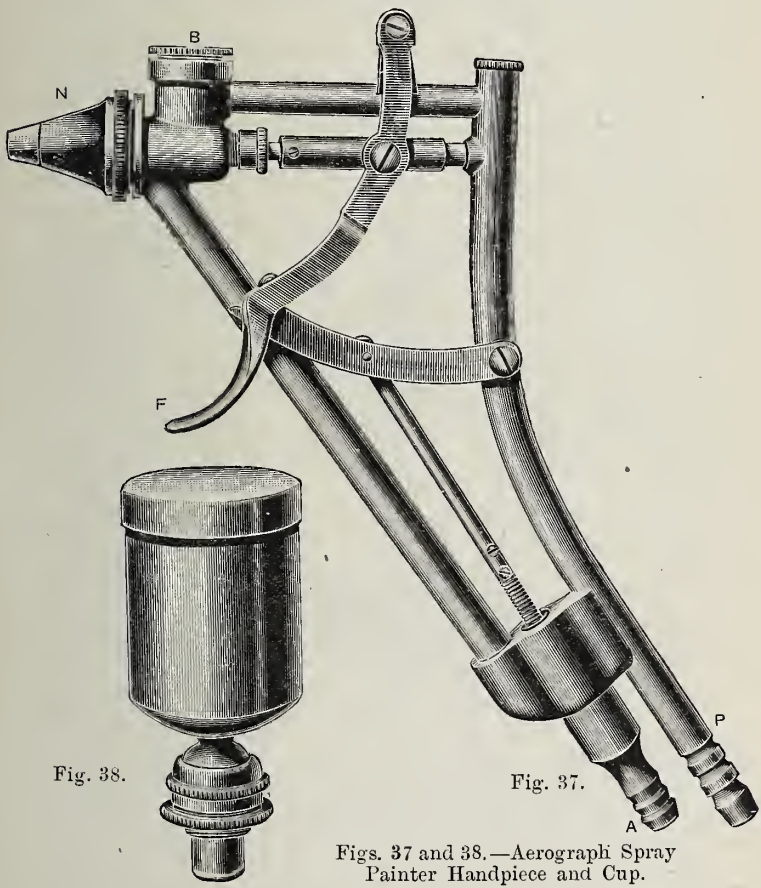


Fig. 38. Fig. 37.

Figs. 37 and 38.—Aerograph Spray Painter Handpiece and Cup.

supply through the tube P. The cup is useful when small quantities of colour are wanted with frequent changes. A ball joint permits of work on a table or a ceiling being done. The tips or spraying nozzles are made in three

sizes—No. 1, for small stencil work, etc.; No. 2, for solid painting in oils; No. 3, large enough for limewash.

By means of the Star machine (Fig. 39), whitewashing, cold-water painting, and calcimining can be done rapidly, cheaply, and with the least possible degree of inconvenience. Scaffolding is not needed, and all cracks and crevices, some of which may be quite inaccessible to the brush, are easily reached and filled by means of the machine, which is a portable but powerful pump, drawing its supply from a suitable vessel, and forcing the fluid through a hose, at the end of which a suitable nozzle, or

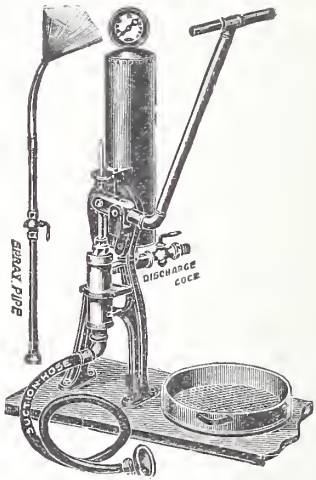


Fig. 39.—Star Whitewashing Machine.

spray-producer, delivers the stuff as directed. A pressure-gauge being provided, the pressure can be nicely regulated in accordance with the greater or less density of the mixture used, or to suit any peculiarities of the surface or of its situation.

Whilst machine-painters working on the spraying system may often prove great labour-savers, they are not suitable for work in which the proper union of the protective coating and the surface can only be gained by well rubbing in the paint with good brushes.

CHAPTER III.

MATERIALS USED BY PAINTERS.

The painter can hardly take too much pains to become acquainted with the properties of his materials. One of the greatest causes of inferior durability is the employment of inferior materials. To obtain the best results, the pigments and the vehicles must be pure and unadulterated. The linseed oil should be of good colour, and flexible in use. The unsightly yellow tinge in white and light tints if often due to new or adulterated white-lead. White is very apt at any time to lose not only its purity of tint, but also its gloss or brilliancy, when exposed to the atmosphere, and this is especially the case in sea air.

The nature, composition, and manufacture of pigments, oils, and varnishes is fully described in the companion volume, "Painters' Oils, Colours, and Varnishes," but sufficient information on this subject will be given here to enable the painter to use his materials intelligently. Varnishes and stains are dealt with separately in Chapters XI. and XII. respectively. Reliable methods of detecting adulteration are described in the companion volume above mentioned.

White-lead (a mixture of 7 parts of lead carbonate and 3 parts of lead hydrate) is, on account of its great body or covering power, generally used as the common base of paints. It is a very tractable medium, retaining any touch, and will lay off perfectly clear or retain a brush-mark. It combines well with most pigments, but injures those of vegetable origin. It is highly poisonous, and should not be allowed to touch the flesh.

White-lead, which is practically the main ingredient of oil-paint, is used for all work requiring body, and is easily and therefore extensively adulterated. Trouble with white-lead may arise from one of three causes: (1) Bad or unsuitable oil; (2) imperfect manufacture; (3) adulteration. In the manufacturing of white-lead, metallic lead is placed in pots of a curious construction, and the lead subjected to

the action of vinegar. The pots are placed in a row and covered with boards, above these being 3½ ft. of spent tan bark, then another row of pots and bark, and so on till the room is full. The lead remains thus for three months or ninety days, and is then taken out.

White-lead ground into the state of dry powder will keep indefinitely, but ground with oil it quickly hardens and becomes useless if exposed to the atmosphere. White-lead in oil is usually kept in casks under a layer of water, and it will be adaptable for use for a long time if treated in this way, though it hardens slowly.

Refined linseed oil is mixed with white-lead owing to its exceedingly pale colour, which does not discolour the white-lead as does ordinary raw or boiled linseed oil, which gives a yellowish tint. The bluish tint is caused by the addition of a small quantity of brunswick blue or ultramarine before the material is ground into a paste; the blue is added to counteract the yellowish tint so characteristic of dry white-leads.

The white pigments which may be looked upon as substitutes for white-lead are Glasgow white, zinc white, Orr's white enamel (or Charlton white), Griffith's patent zinc white, and Freeman's white. . All these pigments have one advantage over white-lead—that is, they are not so readily acted upon by sulphuretted hydrogen; therefore, if used in towns where foul gases are likely to be evolved, they do not so soon blacken. Some of the substitutes do not change colour at all in situations where white-lead would rapidly become discoloured; zinc white, Orr's white, and Griffith's white, for instance, are not affected.

White-lead has greater body and covering power than any of the other white pigments, none of the substitutes being quite equal to it in this respect, whilst some are rather poor in these qualities. Those substitutes containing sulphide of zinc discolour pigments containing copper or lead, owing to the formation of the sulphides of those metals. This defect is not shared by white-lead, though white-lead is itself discoloured by other pigments —cadmium sulphide, for instance.

The principal substitute for white-lead is zinc white, which is prepared by the action of heat on certain compounds. The carbonate or hydroxide of zinc is subjected

to great heat, which causes the zinc to lose part of its constituents, the residue being crude zinc white or Chinese white. It is then cleaned, levigated, and dried. Zinc white is prepared for water-colour painting by grinding it through levigating or flat stones into a pulp with water until quite free from grit, after which it is placed in collapsible tubes. Zinc white may also be prepared by simply grinding with water through a small cone or pug mill. Zinc white requires more oil in mixing than white-lead. It easily powders, does not spread so well under the brush, and has little body; consequently, it is of no use for outside work. Freeman's white is said to be a mixture of zinc and lead, and to combine the virtues of both these pigments.

Red-lead is a brilliant red in colour, and may be prepared by exposing the monoxide at a faint red heat, unfused, for a long time to the air. It is the best priming for metal work, to which it clings persistently; but it should not be used for work which is to be afterwards varnished, or for woodwork. It causes varnish to become dull. Its strong colour is of a very lasting nature, surviving after superimposed colours have worn off or faded. White-lead is preferred to red-lead for priming, since it fills up well, hardens, and harmonises with all succeeding coats of paint. Red-lead may easily be distinguished from all other pigments (except those containing lead, litharge, or white-lead) by heating a small quantity on charcoal before the blowpipe, when a small malleable button of metallic lead will be obtained. If the blowing operation is carefully performed, impurities present will remain on the charcoal.

Litharge or massicot is the monoxide of lead. If lead be melted and exposed to the air a film of litharge will be produced. Common litharge is the monoxide which has been fused. The oxide is a straw-yellow colour.

There are several tests for impurities in white-lead, among them being the following:—(*a*) Scoop out a hollow in a square block of charcoal, and in this hollow place the white-lead to be tested. By means of a blow-pipe direct the outer part of a flame upon the white-lead, and in a few minutes it will be converted to blue lead. The residue, which will be in the form of dust, will be the

adulterant. (*b*) Place some of the white-lead on a palette knife or in a ladle and hold it over a fire ; if only pure lead is left in the ladle, the white-lead is pure, but if there is any ash or other foreign matter, the lead has been adulterated to that extent. (*c*) The specimens of white-lead should be rubbed up with a little sulphuric acid on a glass slab, using a bone palette knife or strip of glass. · If the lead is of good quality, a smooth, pulpy mixture will be the result; if the lead is bad, a curdy incohesive mass will be produced. (*d*) Mix the white-lead with turpentine, and allow to settle; pour off the liquid, and mix the residue with benzine, and allow to settle; again pour off the liquid, and dry the residue on blotting-paper. If this dry residue is shaken up with nitric acid, all of it that is pure lead will dissolve. That which does not dissolve is the adulterant. (*e*) If white-lead is boiled in nitric acid and allowed to settle, the sediment will be the adulterant.

To test the covering powers of different samples of white-lead, mix them into paint, separately weighing out the vehicles, and, having prepared two black boards, one for each sample, paint one coat of colour all over the board, paint another coat over two-thirds of its surface, and a third coat over one-third. It will then be seen which sample possesses the greatest covering power.

To test the fineness of white-lead, rub both samples in a measured quantity on the same piece of glass. By holding the glass up to the light any difference in fineness as well as of density will be seen. To test for fineness, whiteness, and colouring properties, take two glass jars of the same translucency, and put in each a pint of pure turps; then place in each jar an equal amount of lead (rubbed up), and mix well. When the contents of the jars settle, it will be easy to see which is the whiter by looking at it from the side whence the light proceeds. For fineness and covering, look through the jars from the opposite side. Finely ground lead takes longer to settle than the coarse variety.

Another simple way of testing white-lead is to ascertain its relative opacity. A given quantity of pure white-lead (say 100 parts by weight) and 2 parts of lampblack should be well mixed and rubbed out with oil on a slab or piece of glass. Then take the same weight of the sample which

is to be tested and treat it in a similar manner, and place both the samples side by side on a piece of glass. The pure white-lead will be a light drab, whilst the sample will be a dark drab if adulterated with barytes. The more the lead is adulterated, the darker the drab, for the barytes, having no staining property such as white-lead has, requires very little colouring matter to change its shade, being quite transparent when rubbed out with oil.

Red-lead may easily be tested for purity by taking any quantity of the suspected sample and boiling with nitric acid until it is thoroughly decomposed. Any insoluble matter can be filtered and weighed. Any yellow stain that may appear in the solution indicates iron. Treatment with dilute sulphuric acid results in a precipitate of sulphate of lead, which should be filtered and weighed, when the weight, multiplied by 0·955, gives the quantity of the pure red-lead in the sample.

The most important vehicle used in mixing paint is linseed oil. This oil is extracted from the seed of the common flax plant (Linum usitatissimum), which is cultivated chiefly in Russia, America, India, and around the Baltic. The seed varies in quality, the Baltic seed being the most valuable, as it yields a finer oil than any other.

Two different processes of extracting the oil are employed—namely, the cold-drawn process and the steaming process. In the first-named process the seeds are bruised and crushed, and the oil is expressed without heat. The product is a pale oil, which does not keep so well as that resulting from the steaming process. In the steaming process the seed is first crushed by means of heavy steel rollers, and then ground fine under edge-runner mills. It is then submitted to a steam heat of about 200° F. in a steam kettle. The seed, in specially prepared bags, is subjected to hydraulic pressure, and the oil, as it runs from the presses, is pumped into large tanks, where it is left for two or three weeks to allow the sediment or "foots" to settle. The seed yields from 22 per cent. to 27 per cent. of oil. The seed is moulded and pressed into a variety of shapes, generally known as linseed oil cakes, which are used for feeding cattle.

The bleaching or refining of linseed oil is usually effected by means of a 2-per-cent. concentrated solution

of sulphuric acid, which is well agitated with the oil, and finally given a good washing. The bleached oils are used principally by paint manufacturers for grinding white-lead, zinc white, and other delicate-coloured pigments, which the oil does not discolour.

Boiled linseed oil, as used by painters, is prepared by boiling the raw oil either by furnace heat or by steam heat, and adding various kinds of driers, as acetate of lead, red-lead, litharge, and the borates, resinates, and linoleates of manganese. The linseed oil is run into a large tank containing a steam coil; the oil is then heated to 200° F., driving away any moisture the oil may contain. Air is then blown through the oil by means of an air-pump, the oil being agitated by means of a vertical shaft having two or more blades. The driers (usually 2 lb. to each 1 cwt. of oil) are then added very slowly. The oil is run off into tanks to settle, the clear oil being finally run off for use. Boiled oil is soluble in shale spirits, benzine, carbon bisulphide, and turpentine. If boiled with potassium or sodium hydrate, the oil is saponified.

When exposed to the air, both raw oil and boiled oil absorb oxygen, the boiled more rapidly than the raw; the absorption in the boiled oil is aided by the addition of driers, which increases the oxidisation of the oil and assists in the formation of a hard resinous crust. Boiled oils are mostly adulterated, the chief adulterants being resin and mineral and Niger seed oils.

Raw linseed oil, though often specified for outside work, is more suitable for mixing pigments to be used for interiors. Boiled oil, to which litharge has been added, is preferable for outdoor work because of its extra body and brilliancy, and in all cases in which rapid drying is required, although its darker colour disqualifies it for use with delicate tints. The property which gives linseed oil its special value as a paint oil is that when exposed to the air it gradually becomes hard—dries up—in doing which it takes from the atmosphere a large proportion of oxygen, forming a new compound of a resinous character, the properties of which have never been fully investigated. In this power of combining with oxygen, linseed oil is distinguished very markedly from other oils, which have little or no power of combining with oxygen.

Raw linseed oil is added to boiled linseed oil to prevent cracking, and turpentine is added to neutralise as far as possible the tendency of boiled oil to darken with age. Raw linseed oil dries very slowly, especially when used with sienna or vandyke, and it should not be used without driers. Raw oil is thinner than boiled oil, works easily, and wears well as a binder to colour. It allows of the coats of colour being laid on thinner, and so hardening through more completely. Raw linseed oil should be kept corked up for two years to allow impurities to settle.

Linseed oil destroys the colour of vermilion and of crimson lake, which pigments, moreover, are apt to settle as a sediment in the pot; they should therefore be mixed with varnish instead of with oil.

One gallon of linseed oil weighs rather more than 9¼ lb. (correctly 9·3 lb.), thus there are 12 gal. in 1 cwt. of oil; 1 gal. of turpentine weighs more than 8½ lb. (correctly, 8·67 lb.), and 1 cwt. will contain 13 gal. A barrel of turpentine contains 36 gal.

The specific gravity of linseed oil varies between ·932 and ·937; most other oils that could be used as adulterants of linseed oil have a lower specific gravity, cotton-seed and hemp-seed oils being ·930, walnut oil ·929, poppy-seed oil ·926, sunflower-seed oil ·925, earth nut ·918, and colza ·914; mineral oils have a lower gravity still, while resin oils have a very high gravity, hence the specific gravity is a guide to the purity of linseed oil.

The drying power of oils is directly proportional to the amount of oxygen they are capable of absorbing, hence Linache's test is a good one for the purpose. A large watch-glass is taken, and upon it is spread about 1 gramme of precipitated lead; the watch-glass is then weighed, the oil, about ·6 gramme or ·7 gramme, is dropped upon the lead, and the whole weighed to get the exact amount of oil taken; the watch-glass is then exposed to light in a place free from dust; after two days the glass may be again weighed. Linseed oil treated in this manner gained 14 per cent. in weight, while walnut oil gained only half that amount, and the other oils much less.

Maumene's test is also very useful and is easily carried out. Fifty grammes of the oil are weighed out into a beaker, and this is placed in a larger beaker, the space

between the two being filled with cotton-wool; 10 c.c. of concentrated sulphuric acid are run gently into the oil from a burette, the oil being stirred with a thermometer during the operation. The oil is charred and decomposed by the acid, the temperature rising considerably; linseed oil yields a rise of temperature of 103° to 124° C. Some of the fish oils give an equal or even a greater rise, but the other seed oils are much lower, cotton-seed oil being about 75° C. To determine the rise, the temperature of the oil before the experiment is deducted from the highest temperature recorded. Boiled linseed oil has a specific gravity of about ·945, and in other particulars differs from the raw oil.

There is a great number of other tests for linseed oil, all of which are described in the companion manual, "Painters' Oils, Colours, and Varnishes."

Gold-size is prepared in two conditions for the painters' use—as oil gold-size and japanners' gold-size. The latter, which is a quick-drying size, is used for outside work, but is inferior to oil gold-size, which is made from oil-skins, etc., that have been allowed to stand for years exposed to air in order to become "fat." It is mixed with yellow ochre and sold as prepared gold-size. Generally the size has to be further treated to suit different requirements; fat oil is added to it to increase its drying properties. The longer it takes in drying, the brighter is the gilding.

Boiled oil, and sometimes japanners' gold-size, is used for quickening it. The gold-size, when ready for the application of the gold-leaf, is of such a consistency as to hold the gold-leaf without absorbing it; but such absorption is likely to occur if the leaf is applied too soon.

The drying capacity of japanners' gold-size varies from a quarter of an hour to one hour, that of oil gold-size from twelve hours to three weeks.

Baltic oil is superior in drying properties and in other respects to Black Sea and East India oil. Walnut oil is said to be superior even to linseed oil for drying properties, but it costs much more, being chiefly used by artists. Hemp-seed oil is seldom used by painters in this country, on account of its high price. Poppy-seed oil is a drying oil, sometimes so prepared as to be colourless; it is not used in house-painting, being inferior to linseed oil.

Oil of turpentine, spirit of turpentine, and ordinary or common turpentine are all the same thing. Crude turpentine is turpentine as it is derived direct from the pine trees. Oil of turpentine is really the essential or volatile oil of turpentine after distillation, and must not be classed with the ordinary kinds of oils, such as linseed oil, olive oil, etc., which are non-volatile, and have a different composition altogether. There is an oil of turpentine known as fat oil of turpentine, but this is simply ordinary turpentine that has been exposed to air for some time and has become thickened or partly resinified by oxidation. Turpentine is an essential or volatile oil; it prevents colour from spreading, helps it to penetrate, makes it flow well, hardens it, and causes the paint to set quickly. As, however, it destroys all gloss, it should never be added to varnish. Turpentine dries mainly by evaporation; when used as a thinner for paint it causes it to dry with a flat or dull surface. Paint compounded with turps alone can be rubbed away by friction.

The only simple method of testing the purity of turpentine is the test by smell, a guaranteed sample of pure American turpentine being used as the standard. The test may be aided by slightly warming the samples. Turpentine, if adulterated with substitutes such as resin, spirit, or coal-tar naphtha and shale spirits and then heated, gives off a pungent odour entirely different from pure American turpentine. Another method is to distil the turps; this would require special chemical apparatus, such as retorts, stills, etc. The pure turpentine and turpentine substitute, when distilled, pass over at different temperatures; therefore the various temperatures at which the samples distil should be compared with the distillation temperatures of the adulterants, when the approximate amount of the adulterant may easily be determined. By weighing the amount obtained at the various temperatures, the quantity of each adulterant also may be ascertained.

Petroleum spirit or benzoline may be used as a substitute for turpentine, but there are disadvantages which detract from its usefulness, otherwise it would have come into use long ago. It forms a more fluid paint than turpentine, that is, it does not produce such a good body.

Driers are materials whose nature it is to accelerate the drying of paint. They are added in quantities varying according to the condition of the colours, and the work for which they are required. Used too freely, they affect the durability of the paint, and the less driers used the longer will the paint last. Colours which dry without any external assistance last the longest. Some colours, such as the siennas, vandyke brown, etc., are very slow-drying. Driers are sometimes added to counteract an excess of oil in the paint.

Among the many driers in use may be mentioned patent driers, white vitriol, sugar of lead, litharge, borate of lime, borate of zinc, borate of manganese, and terebene. It is a curious fact that an overplus of driers will retard the drying of paint; but it is impossible to name a proper quantity to use, as this is always governed by circumstances. For white-lead colour, litharge is best, as it is of the same nature as the lead. Terebene is so powerful a drier that it will cause colour to dry on a candle. Patent driers are most commonly used, but these should be used with caution, as they vary in quality. They are bad if they show a dark matter on the top of the keg, have a brittle skin, turn a livid white under water, or have a body. An excess of terebene causes cracking. Resinous substances, such as japanners' gold-size or varnish, are also used as driers, but if used too freely they make the paint brittle and cause cracking. Drying oils, such as boiled linseed or drying oil, nut oil, etc., will cause the colour to dry without any further addition.

Driers are resorted to because of the necessity of paint drying quickly enough to escape damage by dust, etc. The more driers put to the colour the quicker it dries to the touch, but not all through. Too much driers prevents the colour from getting hard; a deal of the cracking is caused by too much, or bad, driers. From this cause the paint is liable, by the action of the atmosphere, to form a kind of soap, if the driers contain borax, resin, and naphtha. Driers hasten the drying of the colour, but shorten its life.

Driers in paints should not exceed from 3 to 5 per cent. by weight of siccative, and to ascertain the correct proportion the paint should be required to dry hard in twenty-

four hours. For lead colours increase the amount of driers, though for red-lead do not use any driers at all. For non-tacky coatings on floors, chairs, etc., and for graining grounds, always employ lead colour as the foundation and a lead preparation as the drier, but do not use lead driers in pure zinc white preparations and in white lacquering.

The whole subject of drying oils is highly technical, and much remains to be learned as to the behaviour of the various oils in drying. Instead of attempting a lengthy explanation here, it is better to refer the reader to the companion volume "Painters' Oils, Colours, and Varnishes," where the subject is discussed as fully as present-day knowledge permits.

Patent driers in the form of paste may be used for work where the time is not limited, and for most inside work. Liquid driers may be used for quick work, or work liable to be affected by the weather. The more time allowed the work in drying, the longer the paint will last. Liquid driers, whilst very useful in certain circumstances, have a tendency to make the paint brittle. The amount of driers to be used depends on the strength of the driers, the nature of the pigment, and the state of the weather, the variation being 1 part to 8 parts of driers to 25 parts of paint.

It will save much trouble if all driers are tested before use; this can easily be done by thinning the paste with turpentine to about the consistency of paint, then painting a smooth board with it, allowing the board to stand in a warm place. A good drier will be hard in an hour or two; at the outside, it should not take more than six hours. A good boiled oil would be nearly dry in that time, and would in any case dry in twelve hours.

Terebine, a very powerful drier, has been mentioned. This may vary in composition, but it usually consists essentially of boiled linseed oil and turpentine. The following recipe will give about 4 gal of terebine: Place in a suitable iron vessel 3 lb. of powdered litharge, 2 lb. of red-lead, ½ lb. of sugar of lead, and 1 gal. of boiled oil. Heat over the fire for about half an hour, constantly stirring. Allow the mixture to cool down somewhat, and add 1 gal. of japanners' gold-size and 1 gal. of American turpentine, stir well, and pass through a fine strainer. The

terebine is left for about fourteen days in order to brighten, when the clear top portion is ready for use. This terebine will possess good drying properties, and may be used for any purpose.

Pigments will now be discussed; those serving as bases (white-lead red-lead, etc.) have already been mentioned. Natural pigments are usually preferable to those produced by processes of manufacture. Raw umbers and raw siennas, for instance, are more durable than burnt umbers and burnt siennas. As a rule, however, burnt umber should not be used for outdoor painting, for which work a mixture, to the required tint, of lampblack and some oxide colour, such as venetian red, gives more satisfaction.

For full particulars of all the following pigments, the reader may consult the companion volume, "Painters' Oils, Colours, and Varnishes," there being room here only for a mere list, with the briefest possible particulars as to the nature of the pigments.

White pigments include white-lead, a basic carbonate of lead; flake white, pure white-lead ground in refined poppy-seed oil; kremnitz white, a mixture of white-lead and zinc white, the latter already having been described; charlton white and lithopone, composed chiefly of zinc sulphide, zinc oxide, and barium sulphate; glasgow white, sulphate of lead prepared from natural lead sulphide; barytes, natural barium sulphate; gypsum, natural calcium sulphate; kaolin, or china clay, naturally decomposed felspar; and whiting, spanish white, or paris white, all varieties of chalk.

Blue pigments include prussian blue, known also as chinese, paris, and berlin blue, now made from two salts of potash—the ferrocyanide and the ferricyanide; brunswick, antwerp, and celestial blues, prussian blue containing barytes or gypsum; Williamson's and Turnbull's blues, two varieties of soluble prussian blue; ultramarine, obtained originally from the mineral lapis lazuli, but now manufactured in two chief varieties, soda and sulphate ultramarine; Thenard's blue, smalt, and cœruleum, three kinds of cobalt blue; cobalt ultramarine, a calcined mixture of alumina and cobalt phosphate or arsenate; blue verditer, the treated precipitate formed by mixing solutions of copper sulphate and soda carbonate; lime blue,

hydrated carbonate of copper containing lime sulphate; mountain blue, ground azurite—the native hydrated copper carbonate; and, scarcely ever used, indigo, derived from the plant of the same name.

Chrome pigments include many tints of lead and zinc chromes—the chromates of lead and zinc respectively; derby red, mock vermilion, and persian red are names applied to various sorts of chrome red. Guignet's green, or viridian, is a chrome green chiefly consisting of oxide of chromium.

The lake pigments include madder carmines, reds, purples, browns, etc., and consist of metallic bases which have absorbed colouring matter from solutions; there are also natural lakes—very expensive pigments; alizarin and eosin lakes—the latter called vermilionettes and royal reds—are also known; yellow lakes are produced by precipitating vegetable dyes upon an alumina base; dutch pink is a wood lake; carmine lake and crimson lake are the brilliant pigments formed from the cochineal insect; indian lake is prepared from lac dye produced by treating stick lac with dilute alkali.

Green pigments include brunswick green or bremen green, a common method of making this being to mix chrome yellow with prussian blue, there being also other methods; Scheele's green, a poisonous basic arsenite of copper which should be avoided; emerald, schweinfurt, or paris green, another and finer arsenical green; mineral green, an artificial arsenical green, or a natural product; verdigris, basic acetate of copper, and a very ancient substance; mountain green, native carbonate of copper; cobalt green, a compound of the oxides of cobalt and zinc; terre verte, or green earth, a natural product; and royal green, a mixture of zinc chrome and prussian blue.

Red pigments include red-lead, or minium, prepared from metallic lead; many natural reds such as oxide red, indian red, turkey red, scarlet oxide, spanish brown, purple brown, iron red, etc.; vermilion, sulphide of mercury, occurring native as cinnabar; and vermilionette.

Brown pigments include the many varieties of umbers and ochres, these being natural pigments; vandyke brown, a kind of natural peat or calcined bark; cappah or cappagh brown, native product; cassel earth, another natural

substance; bistre, the soot of beechwood washed and dried; and sepia, obtained from the cuttle fish.

Black pigments include lampblack, the soot of oil; gas-black, or carbon-black, a fine variety of lampblack; charcoal-black and frankfort black, wood, peach-stones, etc. heated in a retort and then ground to powder; drop-black, lampblack ground in water; ivory-black and bone-black, respectively calcined ivory and bone waste.

Yellow and orange pigments include some of the chromes and lakes already mentioned; yellow ochre, a natural product; siennas, varieties of yellow ochre; gamboge, a gum resin; cadmium yellow, obtained by passing sulphuretted hydrogen gas through a solution of cadmium chloride or sulphate; naples yellow, generally containing cadmium yellow mixed with a white pigment; king's yellow, or imperial yellow, arsenic sulphide; cobalt yellow, or aureolin, a double nitrite of cobalt and potassium; mars yellow, an artificial ochre containing iron; indian yellow, made from the urine of cows fed upon the leaves of the mango tree.

Bronze colours are metallic powders produced mechanically or chemically, the metals used being gold, silver, aluminium, copper, and many special alloys.

Painters' knotting is shellac solution, and is used for painting knots in new woodwork. A quarter of a pound of powdered shellac is dissolved in 1½ gal. of methylated spirit; to do this, place it in a warm place, and frequently agitate it. Made this way, it will require shaking up before being used. It will not pay to make it, patent knotting being cheaper and superior. Where patent knotting is not available, french polish will answer the purpose of stopping-out the knots.

Patent knotting is made in the following way: Procure 2 lb. of orange shellac, 2 oz. of pale resin, and 1 gal. of methylated spirit. Powder the resin, put all the ingredients into a large stone bottle, and place in a hot-water bath, stirring them at intervals until they are thoroughly dissolved. A cover should be placed over the bottle neck to prevent evaporation of the spirit, but the bottle should on no account be tightly corked. The method usually adopted by manufacturers is to have the ingredients placed in a steam-power churn. The shellac

varnish or knotting thus prepared is run through a fine sieve and then allowed to rest about fourteen days, when the clear top portion is ready for use.

The painter uses large quantities of putty as stopping, and putty is a material of varying quality. A very cheap putty was tested once, and found to contain 2 parts of fish oil, 1 part of mineral or lubricating oil, and 1 part of raw linseed oil, the base being a mixture of equal parts of whiting and sand. Obviously it would be impossible to carry out a reliable job with such a composition. In the first place, the fish oil contains a large percentage of moisture, which causes the putty to crumble after being placed in exposed positions a few months; whilst the mineral oil, instead of drying hard like linseed oil, separates freely from the whiting, and causes it to turn into a hard, lumpy mass. The best ordinary putty consists of whiting and linseed oil only. Thus there is a simple test for detecting the adulteration of linseed oil putty with mineral oil, which, being a non-drying oil, separates after standing in the package about fourteen days, and comes to the surface, when it may be easily compared with linseed oil. Putty made with linseed oil turns hard after a reasonable time in a uniform mass, without the oil separating. Much sand used with the whiting causes the putty to crumble, because the sand consists of a large number of particles, which cannot combine like whiting to form an adherent mass. Excess of sand may be detected by adding a small quantity of linseed oil to the suspected sample and mixing to the consistency of paint. Then place the sample on a small piece of glass, and rub backwards and forwards with a palette knife, when the grit, which in the case of unadulterated whiting is hardly perceptible, is most marked where an excess of sand is present.

It is probably better and cheaper to buy putty ready made; but in many paint shops a stone slab or wooden block and a mallet or pounder are provided for compounding the whiting and raw linseed oil. The more beating and working in making the putty, the better will it be. Hard stopping putty consists of 1 part of whiting, 1 part of dry white-lead, and sufficient raw oil to make it of the right consistence, a little litharge also being added to hasten the drying.

Of late years the painter has been less dependent upon paints of his own compounding, the manufacturers having come to his aid with a number of special and extremely useful preparations, a few of which will now be noted.

Aspinall's enamel is well known for its brilliant gloss, and for the ease with which it works. The special *O* quality for painters' use can be had tinted to match any pattern for interior work, but for exterior work another quality is supplied. Articles coated with *O* quality enamels may at any time be washed down, when they present a surface as clean and as shiny as on the day that they were first applied. Aspinall's, Ltd., manufacture a variety of liquids for decorative purposes, as well as the now well-known sanitary washable distemper sold under the name of Wapicti, which combines the qualities of a strong disinfectant and an antiseptic agent. This dries with a dull, flat surface, similar in effect to fresco painting, and can be had in a wide variety of colours. For damp walls, Wapicti may be mixed with a petrifying liquid. It may also be advantageously employed for stippling purposes.

Velure, a comparatively new Japan paint, dispenses with varnishing, and one coat is often sufficient, while two coats give a high degree of finish. The proprietors claim that whereas the cost of coating 90 yd. super. with lead paint and varnish (three coats of lead paint and one of varnish) is, including labour, £3 4s. 6d., a better result can be obtained with Velure at a total cost of £2 6s. 8d., representing a saving of 17s. 10d. It is claimed for Velure, moreover, that its much greater elasticity renders it far more durable and more sanitary than ordinary lead paint. It is said not to crack, chip, peel, blister, or fade, and is unaffected by sunshine or frost, sea air, or noxious gases. It has been successfully used out of doors and indoors for a great variety of work, including ships, bridges, public buildings, signs, carriages, bicycles, etc., and even on tarred surfaces and creosoted poles, though the last-named require specal treatment.

Ripolin is described as a perfect paint, which does not require varnish, and which dries with a smooth, glossy surface that will not crack, chip, blister, or peel off. It undoubtedly possesses a high degree of elasticity, which is claimed to be permanent, so that when applied to materials

that expand and contract according to the variations of the temperature, the surface remains unimpaired. The variety specially used for this purpose is known as Gloss Ripolin. It is claimed that 1 gal. of it will cover (one coat) from 60 yd. to 70 yd. super. It is made in sixty-eight stock shades. Flat Ripolin has an egg-shell finish, and all the washing and wearing properties of the Gloss Ripolin, and can be used for either outdoor or indoor work. A quality known as Bridgepaint, which, while superior to ordinary paint, does not possess the beautiful surface of Ripolin, is recommended for covering large structures. It is strongly anti-corrosive, and thus protects ironwork from rust, and resists the action of sulphuric acid. White Ripolin is a substitute for tiling for the surfaces of operating theatres, public baths, and similar buildings. Ripolin may be washed with strong antiseptic fluid and disinfectants without detriment to its surface. Cement Ripolin is a special preparation for coating dry cement and walls, and is recommended for use on granite plaster, Keene's cement, adamant, parian cement, etc.

The Silicate Paint Company, of Charlton, S.E., manufacture a series of silicate paints which are stated not to contain any injurious ingredients. These paints are prepared from a pure silica obtained from the West of England; this is levigated, calcined, and mixed with resinous substances. Besides their non-poisonous qualities, they are said to stand great heat without blistering, to have no chemical action on metals, and to cover, weight for weight, double the surface that could be covered with ordinary paint.

The well-known Duresco is prepared by the same company. It has more than all the advantages of common distemper, but is even more widely applicable. Unlike distemper, it is non-absorbent, being a sanitary washable water paint, supplied in any desired colours, and suitable either for plain work or for artistic decorations. When applied to brick, stone, or plaster it hardens in such a manner as to indurate the surface. It is stated that 1 cwt. will cover 300 yd., one coat, on plaster walls, and it is extensively used in hospitals, hotels, and other public buildings, as well as in private dwellings.

Vernolene is a water paint suitable for both inside and

outside work, and for plain and decorative treatment. It is claimed to be non-absorbent to moisture, having a body equal to and more durable than that of oil paint, being slow-setting but hard-drying, easy to work, thoroughly washable, disinfecting but absolutely odourless, drying with a uniform flat surface superior to that of flatted and stippled lead paint, cheaper than paint or wall-paper, and producing a more artistic finish. It can be painted, varnished, and gilded upon, and is guaranteed to be absolutely free from lime, whiting, china clay, plaster-of-paris, or any similar deleterious substance. Its base is said to be a chemical product free from lead and other pigments, while it possesses a covering power quite equal to that of lead. Water only is required for thinning down the body colour, in the proportion of 1 lb. of water to 4 lb. of Vernolene. Vernolene will keep for an indefinite period and in all kinds of climates. For outside work on plaster, brick, stone, or cement, it is very suitable, having the advantage over oil paint of keeping its colour when exposed to atmospheric or gaseous influences, and drying free from gloss. It has the advantage over distemper that it is of uniform depth of colour, wet or dry, does not decompose or scale off, does not show damp, and can at any time be either painted or varnished. It can be decorated upon either in the same material or in turpentine colours, and can be thoroughly washed with soap and water when required, leaving the work quite fresh again. On woodwork it can be used as a fireproof paint, and for stopping suction. The covering power of Vernolene, bulk for bulk, is said to be equal to that of genuine white-lead, and, weight for weight, will cover twice as much surface. It is made in scores of tints. Where a permanent pure white is required, such as for a pure white ceiling, the ordinary white body colour is not admissible, as it will go slightly off colour in a few weeks, with a creamy cast. There is a special white for this purpose.

Hall's patent sanitary washable distemper is claimed to have the following advantages: It sets extremely hard; being a strong disinfectant, it is specially adapted for use after fever or other infectious cases, and it is also fatal to insect pests; it is free from caustic and alkali, and, if desired, can be guaranteed to contain $\frac{1}{2}$ per cent.

of cresylic acid; it will not scale off, and paint or varnish can be laid over it without any necessity for sizing; it is non-poisonous, is clean in working, and is well adapted for use in nurseries, bedrooms, or water-closets; white ceilings coated with it will not lose their colour through the action of sulphur, as it does not contain lead; nor will it crack or fall off like ordinary whitewash, while, as a filling for cracks and holes, it will set harder than plaster-of-paris. It is sold in air-tight tins or in bulk, and all that is required in mixing it for use is a little hot or cold water. It is sold in about seventy tints, each of which can be slightly modified in mixing. This sanitary distemper may be applied even to damp walls, and is stated to be perfectly washable three weeks after application.

Torbay oxide paint is claimed to be a good preservative for ironwork. In the opinion of many authorities, iron ought to form the base of any protective covering for ironwork. It seems also necessary that, to attain the proper degrees of adhesiveness, elasticity, and covering power combined, the iron should not be in excess of the other ingredients. These qualities are, it is claimed, possessed by Torbay oxide paint, the base of which is an oxide found at Brixham, Devonshire. This paint does not seem to be affected by extremes of heat or cold, or by the action of sea water; and it has a remarkable affinity for and power of protection to iron. Crosbie's Wolverhampton oxide paints are also well known.

Magnite cold-water paint is sold in a dry form to be mixed for use simply with cold water. It is manufactured in colours and pure white, and is intended for use as an economical paint for all such purposes as mills, manufactories, warehouses, railroad buildings, barns, outbuildings, etc. There are two qualities—one for exterior use and the other for interior use. It can be used equally well on stone, brick, plaster, and wood. It is durable and weather-proof, and it is claimed to be fire-resisting in a high degree. It is stated that the basis of the paint is caseine. Weather-proof Magnite is intended entirely for use out of doors, as it will stand rain and weather exposure, and is valuable for use on brick, stone, and wood. Interior Magnite is intended solely for interior work on brick, stone, wood, and plaster. It is claimed to be very

durable, and to be unaffected by gases. "Petrol," a production of the same makers, is a special product similar to kalsomine or water-colours, but does not contain animal glue, and requires only cold water; it is claimed to be an excellent disinfectant and fire retardant, and is adapted for ceilings and decorative work. It can be applied over whitewash.

Randall's paris white japan is claimed to have all the effect of white tiles, at considerably less cost, and is superior to them for sanitary reasons, because it leaves one continuous smooth surface, without crevices affording lodgment to dust and germs. It can be applied with equal effect on plaster, cement, bricks, wood, and iron, and is as easily applied as any other paint; it is also supplied in colours.

Pittman paint will waterproof anything, it is claimed, from a stone wall or an iron girder down to tissue paper. The paint, having a brilliant natural polish, need not be varnished, and it will dry, in almost every case, in less than an hour; and it is claimed for it that when once dry and thoroughly hardened, it will not blister, crack, or peel off. It is non-poisonous, innocuous, and inodorous, and can be scented with any perfume desired by the user.

Morse's Calcarium is a washable distemper for internal and external application, one of the chief features claimed for it by the makers being that, when the surface to which it is applied requires to be redone, no washing off is required, the new colour being laid over the old. This may, of course, in some instances, be a recommendation; but, say for ceilings of living-rooms, it is impossible to make a good job of re-distempering, or to get the desired even flat surface, unless previous coats of material are thoroughly washed off.

Solignum, a stain and preservative for wood, is claimed to protect wood from dry rot or any other form of decay. It is stated to be vermin-proof, prevents the boring of the teredo in submerged timber, and resists the ravages of the white ant. It is a stain as well as a preservative, being made in three shades of brown as well as in black, and can be polished by means of a special varnish. It is also claimed that Solignum will preserve stonework and brickwork, and is a remedy for damp walls.

Many fireproof paints on the market are made simply from silicate of soda, plaster-of-paris, a little glue-size, and the required dry colouring matter. All the ingredients are kneaded together with water into a working consistency, and used in the same manner as oil paint. Another method is to mix equal parts of finely powdered asbestos and slaked lime, adding a little boiled oil as a binding agent, and thinning the whole down with silicate of soda solution. Mineral colours may be added as desired.

CHAPTER IV.

PAINT MIXING.

In mixing paints, it must always be remembered that some pigments exert a chemical influence upon others, and this must be guarded against. All blues are not chemically suitable for mixture with yellows or reds, nor all yellows with reds; indeed, a knowledge of the chemical source and affinities of pigments is almost a necessity to the painter and decorator. Full information on the subject is given in the companion volume, "Painters' Oils, Colours, and Varnishes," but it will be well to mention here the ordinary pigments which it is inadvisable to mix together.

In oil colour, chrome is an undesirable pigment, and particularly is to be avoided when compounding greens from prussian or antwerp blue, which pigment it would eventually destroy; however, this advice is commonly disregarded. The best ordinary substitute for chrome in oil colour is a bright yellow ochre, and raw sienna can also be used with the above blue pigments without much detriment to either. In any case where a bright mixed green is absolutely necessary, the lemon chrome can be used in conjunction with good ultramarine blue or indigo.

In compounding the secondary colour of purple from blues and reds, there is less danger of trouble arising. For oil painting, the best and purest colour is obtained by mixing ultramarine with madder lake, or ultramarine and vermilion will answer. Prussian blue with vermilion gives a deep purple, which may be lightened with white. For common purposes, the cheap purple brown is most useful, if required full in strength; but if lighter and pure tints are wanted in oil or distemper, ultramarine blue and vermilion (or, for cheapness, venetian red) are necessary. Prussian blue in water would not suit so well, but indigo could be used if cost is not a consideration. The remaining secondary, orange, is a colour not very often re-

quired. Orange chrome or orange red is a bright opaque pigment, but otherwise, like all the chromes, is not a commendable article. Burnt sienna is semi-transparent, reliable, and permanent; it is a remarkably strong stainer, being like prussian blue in this respect. In compounding orange colour, the reds and ochres already mentioned are usually bright enough; yellow ochre and venetian red, or raw and burnt sienna together, give with white-lead a good and serviceable variety of permanent orange and salmon tints.

The compounding of the third division of material colours—the tertiary—from either of the two secondaries, is a subject that need scarcely be dealt with here. The practical student will soon find the secondary pigments of orange and green which produce the tertiary citrine, bright or sombre, as occasion requires. Of the remaining tertiaries, russet and olive, prepared from the purple and orange and purple and green respectively, there is a good supply in the form of simple pigments. Notwithstanding, therefore, the necessity and advantage of the worker being able to obtain any colour by the admixture of the three primaries, it is always more economical to use a simple article of the desired colour when it is to be had.

It must not be thought that there is any one way of mixing paints that is exactly right, while all other methods are wrong. Every painter has his own peculiar method of mixing. In nearly all cases the simplest plan is to use pigments ground in oil instead of dry powder. With a palette knife break up the lead rather stiff, adding a little oil. Thin down each paint until it is slightly stiffer than the whole will be when ready for actual application; or if dry pigments be used, add a little oil and thoroughly mix. The lead, zinc, or other base being ready, add some pigment, and well stir. If several pigments are required to produce the tint, be sure to add only one at a time, and take great care that each one is thoroughly mixed before the next is added. As a further precaution, do not add the pigment all at once, but a little at a time. When it is certain that a thorough admixture has been effected, the next pigment may be added, little by little. Some pigments, such as prussian blue, are very strong, and the addition of too much will spoil the job; and while

it is always easy to add a little more, it is impossible to take any out. Although it takes longer to mix a batch of paint in this way, it is a much safer plan. Of course, an experienced man can add the necessary amount of colours without taking these precautions.

Having mixed the paint, add as much driers as may be necessary, taking care not to use too much; then strain the paint through a fine wire strainer. It is well to mix enough paint in one batch to do the whole of the job in hand, so that there may be no trouble or waste of time in matching tints. Paint mixed in cold weather is very likely to give unsatisfactory results, because the oil will

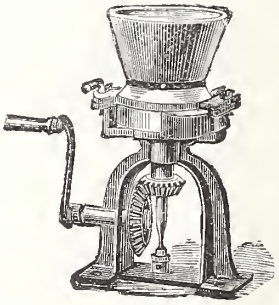


Fig. 40.—Cone Paint Mill.

stiffen and be more difficult to mix perfectly with the pigments. To remedy this, a gallon or so of the oil should be heated, and this poured in will warm up the paint, and prevent it "pulling" when applied.

Nearly every paint shop will find it convenient to have a mechanical paint mixer, of which there are several kinds on the market available, at prices ranging from £2 upwards. Young & Marten's No. 1 A cone mill (Fig. 40) has a capacity of $1\frac{3}{4}$ cwt. a day, the hopper being 7 in. in diameter, the grinding disc 5 in. in diameter, and the total height 1 ft. 2 in. The largest mill of this type has a 17-in. hopper, and can grind 10 cwt. a day.

Wright, Clark & Wallis make the small enamelled mill shown at Fig. 41. The mixing cylinder is hinged, as

shown, for convenience in pouring out the contents, this process being also facilitated by a lip in the edge of the cylinder. The central shaft operated by the handle through the bevel gearing shown has four paddles (see Fig. 42), which effectually mix the paint. Of course, when the cylinder is in use it stands flat upon its bed-plate, as in Fig. 42.

The Little Giant hand-power paint-mixer (Fig. 43), made by Torrance & Sons, Ltd., of Bitton, Bristol, has a

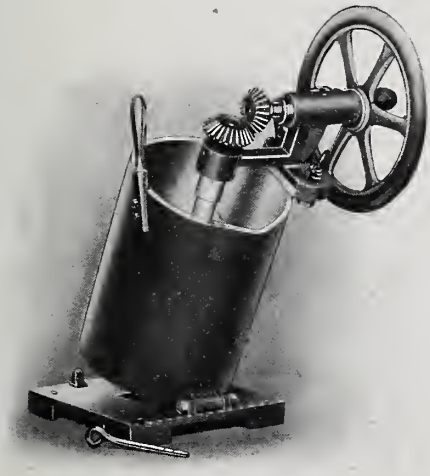


Fig. 41.—Paint Mill with Paddles and Hinged Cylinder.

capacity of 5 gal., which quantity it can mix in a few minutes. The mixing blades can be thrown up on a hinge as shown in Fig. 43, and the drum, or container (measuring 15 in. by 10 in.), can then be removed for distributing the paint. Of course, in use the blades shown in Fig. 43 are working in the container, the two bevel wheels then being in driving contact.

White-lead, which is the principal pigment employed by the house-painter, may be mixed with nearly all colours with the exception of those containing sulphur, as lime blue, ultramarine blue, and cadmium yellow. Zinc white

may be mixed with all other pigments. Its want of body or covering power is its chief objection.

Ultramarine, royal, and lime blues may be compounded with zinc white without the colour being affected. Brunswick or celestial blue, which is of a deep shade, may be prepared in a variety of pale and intermediate shades with the addition of white-lead, and may be deepened with prussian blue or drop-black. It should not be compounded with ultramarine blues.

Brunswick greens may be lightened with lemon chrome or deepened with brunswick and prussian blues; with the addition of lampblack, umber, and yellow ochre in variable proportions, sage, bronze, and olive greens may be pro-

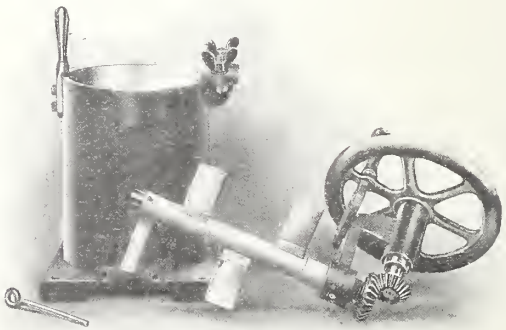


Fig. 42.—Paint Mill Paddles.

duced. Chrome greens may be tinted in a similar manner to the brunswick greens. Emerald green may be lightened with white-lead or chrome yellows and deepened with brunswick or prussian blues.

Chrome and zinc yellows may be lightened by the addition of white-lead and zinc white and darkened with orange chrome, yellow ochre, raw sienna, burnt sienna, and the umbers. Yellow ochre may be lightened with chrome yellow and white-lead, and deepened with raw sienna, raw and burnt umber, vandyke brown, oxides, indian red, and drop-black.

Vermilion may be lightened by adding white-lead, zinc

white, orange, and red-lead, and deepened with carmine, madder red, and most other pigments without being chemically affected. Venetian red and the oxides may be lightened with white-lead, zinc, red and orange lead and vermilion, and deepened with indian red, burnt sienna, purple brown, blue, and ivory-black. Indian red may be

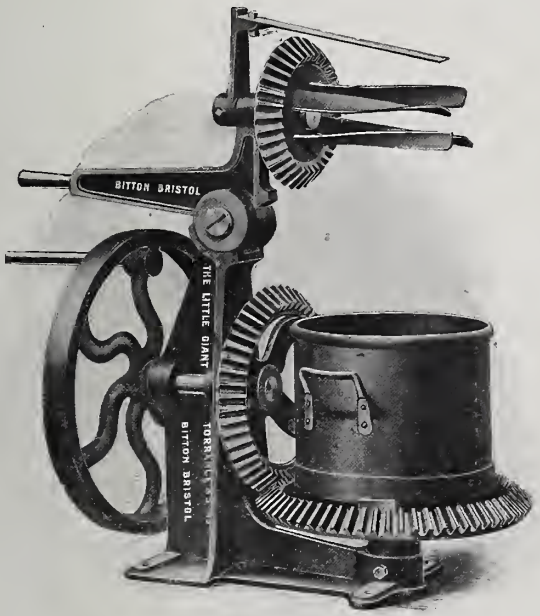


Fig. 43.—"Little Giant" Paint Mixer.

lightened with red oxide, white-lead, signal red, and deepened into a chocolate or brown by the addition of ivory-black or drop-black in variable proportions.

Brown pigments as raw and burnt umbers may be lightened by the addition of white-lead, zinc white, yellow ochre, and orange chrome; almost any shade of grey or drab may be produced by mixing in variable proportions. Brown pigments may be deepened by the addition of

drop- or ivory-black. The above are given in most cases without the addition of black, as this deadens the tints somewhat. Black may be added if required without chemically affecting the pigments.

The list given below will be found useful when preparing tints and colours. As there is no standardisation of colour, the following proportions are given as made from the finest quality of paints and colours; where cheaper qualities are mixed the quantities of the ingredients should be varied to suit. Many who prefer to mix their own particular shade or colour, or who do not care to stock a large assortment of colours, will find it easy to compound whatever shade they require from the following comprehensive formulæ:—

Whites.—Pure white: equal parts white-lead and zinc white. Translucent white: white-lead 1 part, barytes 10 parts. Flake white: pure English white-lead. Kremnitz white: pure zinc oxide 100 parts, ultramarine 1 part. Permanent white: finest barytes 200 parts, blue 1 part. Transparent white: oxide of zinc 1 part, barytes 20 parts. Clear white: white-lead 300 parts, ultramarine 1 part.

Yellows.—Primrose: pale zinc chrome. Lemon: lemon chrome. Buttercup: middle chrome. Canary: white-lead 10 parts, lemon chrome 1 part. Old gold: white-lead 6 parts, ochre 12 parts, middle chrome 3 parts. Transparent yellow: yellow ochre 1 part, barytes 10 parts. Golden ochre: yellow ochre 5 parts, lemon chrome 2 parts. Cream tint: white-lead 100 parts, italian ochre 3 parts. Light stone: white lead 100 parts, yellow ochre 6 parts. Middle stone: white-lead 100 parts, yellow ochre 12 parts. Dark stone: white-lead 20 parts, yellow ochre 12 parts, raw umber 4 parts, venetian red 1 part. Light oak: white-lead 6 parts, yellow ochre 6 parts, venetian red 2 parts, umber 1 part. Dark oak: white-lead 2 parts, yellow ochre 3 parts, venetian red 1 part, umber 3 parts. Buff colour: white-lead 100 parts, yellow ochre 7 parts, middle chrome 1 part. Roman ochre: yellow ochre 50 parts, turkey umber 3 parts. Ash colour: white-lead 50 parts, raw umber 5 parts, yellow ochre 1 part. Maple colour: white-lead 100 parts, yellow ochre 3 parts, raw umber 1 part. Amber colour, burnt umber 3 parts, middle chrome 3 parts, orange chrome 8 parts. Copper

colour: white-lead 100 parts, middle chrome 19 parts, venetian red, umber, and green, 3 parts each. Leather colour: white-lead 20 parts, yellow ochre 5 parts, venetian red 2 parts. Bronze yellow: white-lead 10 parts, lemon chrome 4 parts, raw umber 5 parts. Golden yellow: middle chrome 16 parts, yellow ochre 1 part. Italian yellow: yellow ochre 14 parts, burnt umber 1 part. Hay colour: white-lead 100 parts, yellow ochre 4 parts, raw umber 4 parts, deep green 1 part. Limestone colour: white-lead 100 parts, yellow ochre 1 part, raw umber 1 part.

Reds.—Maroon: venetian red 2 parts, indian red 4 parts, lampblack 1 part. Tuscan red: rose pink 2 parts, indian red 4 parts. Light indian red: venetian red 1 part, indian red 3 parts. Deep indian red: indian red 5 parts, lampblack 1 part. Oriental red: rose madder 2 parts, orange lead 1 part. Turkish red: pale vermilion 4 parts, mahogany lake 1 part. Mauve tint: white-lead 6 parts, prussian blue 2 parts, madder red 1 part. Violet tint: french ultramarine 14 parts, crimson lake 3 parts. Lavender tint: white-lead 100 parts, ultramarine 3 parts, madder lake 1 part. Lilac tint: white-lead 100 parts, ultramarine 1 part, rose madder 1 part. Terracotta: white-lead 2 parts, venetian red 1 part, burnt sienna 1 part. Salmon: white-lead 40 parts, golden ochre 5 parts, venetian red 1 part. Bright orange: orange chrome 1 part, orange lead 2 parts. Mahogany: orange chrome 10 parts, burnt sienna 3 parts white-lead 1 part. Brick colour: venetian red 2 parts, white-lead 1 part. Rose tint: white-lead 16 parts, crimson madder 1 part. Orange red: orange chrome. Indian pink: white-lead 100 parts, indian red 3 parts, rose madder 1 part. Light pink: white-lead 100 parts, rose madder 4 parts, vermilion 1 part. Flesh colour: white-lead 50 parts, yellow ochre 2 parts, burnt sienna 1 part. Purple tint: white-lead 1 part, ultramarine 1 part, indian red 1 part. Cherry red: rose madder 1 part, vermilion 2 parts.

Blues.—Pure blue: zinc white 20 parts, english ultramarine or cobalt blue 2 parts. Sky blue: white-lead 300 parts, cobalt blue 1 part, prussian blue 1 part. Misty blue: white-lead 50 parts, ultramarine 10 parts, burnt umber 1 part. Opaque blue: zinc white 1 part, french ultramarine 1 part. Sea blue: white-lead 16 parts, ultramarine 3 parts, raw sienna 2 parts. Turquoise blue: white-

lead 20 parts, ultramarine 2 parts, light green 1 part. Deep blue: prussian or ultramarine blue. Blue-black: ivory-black 40 parts, prussian blue 3 parts. Royal blue: white-lead 1 part, ultramarine 15 parts. Azure blue: white-lead 150 parts, prussian blue 1 part. Oriental blue: white-lead 100 parts, prussian blue 9 parts, lemon chrome 1 part. Greyish blue: white-lead 20 parts, prussian blue 2 parts, ivory-black 1 part. Sapphire blue: zinc white 4 parts, chinese blue 1 part.

Greens.—Olive green: white-lead 12 parts, yellow ochre 4 parts, ivory-black 1 part. Sage green: white-lead 30 parts, light green 2 parts, burnt sienna 1 part. Middle chrome green: lemon chrome 1 part, middle chrome 1 part, prussian blue 2 parts. Pale emerald green: white-lead 2 parts, emerald green 1 part. Sea green: white-lead 100 parts, deep green 4 parts. Bottle green: light green 6 parts, lampblack 1 part. Pea green: white-lead 100 parts, lemon chrome 1 part, light green 13 parts. Oriental green: white-lead 2 parts, lemon chrome 2 parts, umber 1 part. Blue green: deep green 7 parts, prussian blue 1 part. Myrtle green: white-lead 20 parts, middle chrome 7 parts, ivory-black 1 part. Bronze green: middle chrome 2 parts, raw umber 5 parts, burnt sienna 1 part, black 1 part. Coach brown: indian red 5 parts, Grey green: terra verte 10 parts, raw umber 1 part, white-lead 1 part. Citron green: white-lead 40 parts, middle chrome 3 parts, ivory-black 1 part. Water green: white-lead 50 parts, deep green 2 parts, yellow ochre 10 parts.

Browns.—Golden brown: white-lead 20 parts, yellow ochre 3 parts, burnt sienna, 1 part. Snuff brown: white-lead 9 parts, orange chrome 1 part, burnt umber 2 parts. Foliage brown: vandyke brown 2 parts, burnt sienna 1 part. Coffee brown: burnt umber 9 parts, yellow ochre 4 parts, venetian red 1 part. Cocoanut brown: burnt umber 4 parts, yellow ochre 1 part, white-lead 1 part. Amber brown: burnt umber 9 parts, middle chrome 5 parts, venetian red 3 parts. Walnut brown: burnt umber 5 parts, raw sienna 1 part. Italian brown: vandyke brown 4 parts, raw sienna 1 part. Pale brown: white-lead 4 parts, burnt umber 1 part. Stone brown: burnt umber 10 parts, golden ochre 1 part, burnt sienna 2 parts. Deep fawn: white-lead 10 parts, burnt umber 4 parts, ochre

1 part. Purple brown: indian red 8 parts, burnt umber 1 part, black 1 part. Coach brown: indian red 5 parts, ivory-black 2 parts. Orange brown: burnt sienna 5 parts, orange chrome 4 parts. Light drab: white-lead 50 parts, burnt umber 12 parts, ochre 1 part. Deep drab: white-lead 20 parts, burnt umber 14 parts, ochre 2 parts. Fawn tint: white-lead 60 parts, burnt umber 5 parts, yellow ochre 3 parts. Light stone: white-lead 20 parts, italian ochre 1 part. Tan colour: white-lead 20 parts, burnt umber 6 parts, burnt sienna 3 parts, and yellow ochre 2 parts.

Greys.—Pure grey: raw turkey umber 1 part, ivory-black 1 part, white-lead 40 parts. Light french grey: white-lead 200 parts, ivory-black 2 parts, blue 1 part. Pearl grey: white-lead 50 parts, venetian red 2 parts, deep green 2 parts. Dove grey: white-lead 50 parts, ultramarine blue 4 parts, ivory-black 1 part. Lead colour: white-lead 100 parts, ivory-black 8 parts. Slate colour: white-lead 100 parts, ivory-black 3 parts, ultramarine 1 part.

Blacks.—Purple black: lampblack 5 parts, rose pink 1 part. Blue-black: ivory-black 40 parts, prussian blue 3 parts. Jet black: ivory-black 10 parts, umber 1 part, prussian blue 1 part. Olive black: vine-black 20 parts, yellow ochre 1 part.

CHAPTER V.

PREPARING SURFACES FOR PAINTING.

Priming, the first process preliminary to painting, supplies a foundation for the coats of paint. Linseed oil priming is employed for wood and stucco; the oil binds, spirits being used merely to aid in carrying the filling part of the paint into the pores of the wood, and to harden the paint. In America crude petroleum is regarded as a good substitute for turps in priming.

The nature of the surface—wood, tin, steel, wrought cast, or galvanised iron—governs the character of the priming. Wood presents great varieties of surface. The under edges of doors should be primed before they are fixed, as they present a surface of end-grain which absorbs water readily. This detail, though very important, is generally neglected.

The best way to deal with knots is to cut them out with a saw, and joint a piece of sound wood in; or, if not cut out, they can be laid in with japanners' gold-size and covered with leaf-metal, or dug down about a quarter of an inch and filled with hard stopping. If the knots are very resinous, the blow-lamp should be applied and the resin scraped away; or the knots may be pressed with a hot iron or painted with hot lime, the resin being scraped away next day. It is preferable to gild all hard knots, though some painters merely give them a coat of knotting (see p. 52).

For resinous woods, the priming should contain a large proportion of turpentine, which, also, is required for hard wood, to penetrate the surface. In such a case, an oil priming, without turps, is liable to dry on the surface instead of sinking into the wood, and then either shrivels or blisters. Spongy wood requires more oil than turpentine. Ochre and venetian red, being brittle pigments, do not give good results on hard-grained or cross-grained wood; they are liable, too, to remain on the surface. All

priming should be well brushed in and be made thoroughly level. For soft, open-grained wood, equal parts of ochre and keg white-lead, well ground up together and thinned principally with raw linseed oil, make a good priming, and for hard wood good keg white-lead, mixed with raw linseed oil and turps, in equal parts. For resinous woods, the priming may consist of equal parts of venetian red, yellow ochre, and white-lead, made up with about one-third oil and two-thirds turpentine, with a little driers; it may be mixed with japanners' gold-size and turps.

For priming new plaster, use white-lead thinned with raw linseed oil and allow to stand four or five days. For old plaster, driers and turps must be added, and a second coat given within forty-eight hours. For outside work, boiled oil is employed instead of raw oil.

Galvanised iron should be scrubbed, brushed, and dusted, then washed in water containing 5 per cent. of muriatic acid. The priming should then consist of red-lead and boiled oil; or venetian red may be used with the red-lead (equal parts) to tone down the strong colour of the red-lead, or black may be added to produce a chocolate colour. In preparing metal surfaces for painting, after wrought-iron or cast-iron has been scratched and brushed, it may be further cleansed with a wash of paraffin. Tin must be washed with strong soda first, to remove grease, and the priming may be as described above, but with two-thirds turpentine and one-third linseed oil. Two coats of priming should be given, with more oil in the second than in the first. Priming should dry flat.

When red-lead fails on metalwork, it is either because the lead is inherently bad or because the mill scale or rust has not been removed from the metal; or, again, because the coat of priming has been too oily, or because the work has not been properly covered. A little varnish or japanners' gold-size helps priming to adhere to metal, but only a little should be used; for steel, varnish or japan is essential. The judicious use of a burning-off lamp will help to harden japanners on metalwork. It may be noted that 1 lb. of red-lead and white-lead mixed for priming should cover 7 yd. super. A very small quantity of driers may be used for the priming, but it is better not to use driers when there is time enough for unaided drying.

Red-lead priming is said to injure varnish if applied as a finishing coat to work; it is nevertheless by far the best priming for ironwork. It adheres firmly to the iron, and does not scale, blister, or powder; indeed, mixed with glycerine, it will make a first-class aquatic cement. It is therefore an excellent paint for railings, bridges, glass-houses, etc. Red-lead does not require driers. It hardens chemically when the requisite quantity of good linseed oil is mixed with it, forming lineolate lead-soap, which is insoluble in water or air, and does not decompose any substance with which it comes in contact. This insoluble lineolate soap absorbs about two-thirds of the oil; the other third will dry of itself. Red-lead should be used before saponification occurs—that is, as soon as it has been mixed.

Stopping, puttying, or surfacing, and filling up, have all the same object, and greatly affect the ultimate finish of the painted surface. If badly done, they cause great loss of time. Good painting depends largely upon proper puttying, for a proper foundation is necessary to a satisfactory finish. The object of all puttying is to fill up holes, level the inequalities that are always present more or less in woodwork, and also to fill irregularities of grain.

Puttying, or surfacing, then is the filling up of holes and cracks, and must not be confused with filling, which is a levelling up; although, in order to get a level surface, putty is sometimes used for filling. All small faults, nail holes, joints, cracks, etc., are filled up with a stopping knife, the putty being pressed into the holes, and all levelled so as to require very little after labour. When all defects are made good, all the work should be rubbed smooth with No. 1 glasspaper. The putty must be put on evenly, neither too much nor too little being used; and must be so worked that very little glasspapering will be required afterwards; it must not be switched on and left rough, but carefully spread and finished off without rim at the edges, a piece of rag being sometimes used to prevent this. The edges of the puttying require special attention; no ridges should be left to harden, because a rough accumulation of putty is difficult to rub down when dry.

The putty is applied before the priming coat is quite

hard; the priming then gives a key to the putty. If the putty is well pressed in, it is less likely to sink or swell. A flexible knife should be used, and care must be taken not to dig the edge of the knife into the surrounding paint.

Distemper stopping should not be used for oil-painted work, as it is liable to crumble.

The final process in stopping consists in rubbing down with a piece of worn glasspaper folded over a flat cork or a flat square of wood—a very useful and important operation in skilled hands. Puttying is sometimes done on priming, and sometimes on second colour. The latter gives more hold for the putty, which should be made more elastic if used on second colour. The priming contains less pigment than the second colour, and, consequently, has less affinity with putty.

Putty should be, as nearly as possible, of the same nature as the surrounding paint, and of the same colour. It must cling well, dry well, and be easily glasspapered. Care must therefore be taken that it does not dry too hard, because in this case it will contract in drying and sink, leaving a depression, as well as a crack, at the edge of the stopping; and the putty should be applied before the ground has got too hard for adhesion. If softening is necessary, a "dry" brush of paint must be applied.

White-lead putty should be used from a small putty-board, and not from the palm of the hand, because of its poisonous nature. Take a well-worked piece from this board, and press it into the hole with the putty knife, the superfluous part being then cut away or smoothed with a rag.

Sometimes putty, especially if made with lead deficient in body, will shrink in drying. In this case it is well to leave the stopping a little above the surrounding paint, as in a few days it will shrink, and can then be reputtied and smoothed with the knife.

A little boiled oil can be used with advantage in mixing putty, and white-lead mixed with whiting is sometimes used. The whiting should be dried first, as it always contains a certain quantity of water; but it is liable to crumble. Keg-lead mixed with dry white-lead, being of the same nature as the paint, gives, if properly made, the

best putty for stopping holes in woodwork. Glaziers' putty, known as soft putty, is sometimes selected, but it takes too long to harden. Material for stopping can be made of dry white-lead mixed to a stiff paste with japanners' gold-size, and a very little turpentine will help the gold-size to mix easily with the white-lead. As, however, the putty is now of a different nature from the surrounding oil coat, it should only be used with colour bound in japanners' gold-size.

In surfacing, a sheet of putty can be applied with a knife, whilst filling is generally applied with a brush. To make what is called draw putty, for filling, mix 2 parts dry white-lead, 1 part keg-lead in bulk, add equal parts of rubbing varnish and japanners' gold-size, and thin to a workable consistency with turpentine. It should be remembered that the more rubbing varnish is added, the harder the putty will be to rub down. In making this kind of putty, the materials when plastic should be well pounded with a wooden mallet, and the more the pounding the better the putty. When putty for surfacing is made partly with black or ochre, the several ingredients should be ground in a mill. Vegetable black and ochre are both refractory to combine with oil by hand.

If a dent or depression needs filling up on a painted surface, holes should be made in different directions with a bradawl, so as to give a key for the stopping to cling to.

Draw putty for surfacing can be made of dry white-lead mixed to a slate colour with vegetable black, driers being added. It is made workable by adding one-fourth japanners' gold-size to three-fourths raw linseed oil, and, unless due care is taken, may be made too thick to be applied with a brush and yet too thin for a knife. It should then be put on with a stiff piece of stout leather and rubbed down solidly, and when dry carefully glass-papered; it is then bound down with a coat of sharp colour.

Putty is of an absorbent nature, and is liable to imbibe the oil and varnish applied to the work. A smooth, thin glazing of putty levels surfaces, and can be sealed down with a coat of thin and oily paint after the rubbing down, and thus prevent suction.

Draw putty can also be made of one-fourth whiting,

one-fourth dry-lead, one-half keg-lead, with equal parts of rubbing varnish and japanners' gold-size. This material can be applied all over the work with a broad-bladed putty knife.

The various methods of filling preparatory to painting depend on the object in view; the filling of new woodwork, the filling of old damaged painted surfaces, the levelling of stucco, and the filling of woodwork to be afterwards only stained and varnished, all need different treatment. With respect to the filling for woodwork, the pigments and binders of which the filling is composed should be chosen with a view to the finished appearance, as well as to the nature of the ground. In the case of stucco, which is limy in nature, and is finished principally with lead, the filling should partake of both natures to promote a union of the paint with the surface. Wood that is to be stained and varnished should be filled as far as possible with transparent substances. In the case of old surfaces, an endeavour should be made to restore the faded qualities of the old paint; thus, in levelling old paint, draw putty is laid on with a trowel or a broad-bladed knife, and a filler is generally applied with a brush; but for plain varnished wood the filler is applied with a cloth.

Fillings for woodwork that is to be painted are composed frequently of substitutes for white-lead, which is expensive for the purpose, and for this reason yellow ochre is often used. A mixture of vegetable black and white-lead in equal proportions is a good filling for dark-coloured work. A filling commonly used for woodwork consists of two-thirds white-lead and one-third sifted pumice-stone dust, bound with japanners' gold-size and made workable with turpentine. The pumice dust makes the work cut easily when pumiced level. Filling for wood should be mixed to a heavy consistency. When applied with a brush, it must, when set, be scraped with a broad putty knife, held at such an angle as not to pull up the putty, and pressed swiftly and firmly over the surface. The filling must be applied evenly, and levelled, no bad edges being left. Filling for woodwork should not be rubbed out like paint, but be laid on and smoothed out.

Coachmaker's fillings are sold as yellow, red, brown,

and black powders, and are bound with japanners' gold-size and thinned with turpentine. They are excellent for all but white and very light grounds, and can be laid on with a knife or trowel. This must be done as evenly as possible, so that the work will require but little rubbing down. These fillings can be used as bought, or fortified with one-third by weight of white-lead. When the filling is dry, it is well to give the work a coat of sharp thin colour made of venetian red, to form a guide for cutting down, as at the finish all trace of the red is lost. Another way to apply this filling is to add half by weight of tub-lead to the powder, then work it into a stiff paste with turpentine, and thin down with equal parts of carriage varnish and turps. It is applied with a brush, several coats being necessary. Sometimes a coat of colour is given between each coat of filling, to bind it down and give a key for the coats following. It is a good plan to apply the coats in different directions, one coat up and down, the next across, so as to get more filling with fewer coats, and to avoid marks, especially brush-marks.

Enough filling for the complete job should be made at once, and a day allowed to elapse between the coats of filling, the work being allowed to stand as long as possible before rubbing down; a week is about the time, but a longer interval should be given if possible. The smudge pot may be used up in mixing the preparatory coats; smudge will make tougher paint than freshly mixed colour.

A quick filling can be made of lead 1 part, yellow ochre 2 parts, raw oil $\frac{1}{2}$ part, rubbing varnish $\frac{1}{4}$ part, turps $\frac{1}{4}$ part, a teaspoonful of japan to every quart. One part silex may be added, and driers to dry the raw oil. When keg-lead is used, the oil contained in it helps to modify the hardness of the japan. A little boiled oil, being a good drier, is useful in making up filling. Turpentine causes the japanners' gold-size to mix better with the oil and pigment.

Another filling is made with equal parts of white-lead and driers. Mix it to the consistency of paint with equal parts of japanners' gold-size and turpentine, then add sufficient dried whiting to make it into a paste.

The clearcole or sheepskin process, in which the work

is not washed off, is frequently nothing more than the binding down of dirt and grease with a liberal coat of size and whiting. The surface is thus filled, and the expense of a few coats saved. The only excuse (and that is a poor one) for using clearcole is that it is serviceable in places where the surface is greasy and the paint therefore liable not to dry; even then it is more workmanlike to destroy the grease, and remove the dirt with soda-and-water, if the price will not allow of stripping. The result of using whiting is that the work soon powders, perishes, and cannot be cleaned down.

The object of sizing is to stop suction, and save the expense of oil and paint. It interposes between the paint and the wood a thin skin that has no affinity either for wood or paint, and prevents a close combination of the oil colour with the wood. As the size in drying contracts to a greater extent than the more elastic paint, and is stronger, it draws the paint into cracks. On the other hand, oil priming, by sinking into the grain, adheres to the wood and also unites with all finishing coats of colour. For large stucco surfaces, the use of whiting is necessary on account of the extent and nature of the surface to be covered.

In the case of a slightly cracked surface, a coat of colour moderately round made slightly sharp with turpentine, and mixed with plenty of driers, may be rubbed in with pumice-stone. This will level the surface and fill the cracks. When the price allowed for repainting will not admit of burning off, the old paint must first be levelled up. The work to be repainted may perhaps be covered with minute cracks, with large unsightly fissures in some places. In such a case the surface of dirt and grease always existing in such jobs must first be removed; then all faulty places should be well scraped, and afterwards the dust and dirt well brushed out of quirks and cracks.

When a badly cracked job has to be filled up instead of being stripped, it is advisable to scrub the work by means of a short-haired brush with turpentine instead of water; there is then no chance of moisture getting into and lurking unobserved in cracks. Besides scrubbing with turps, the work should be well pumiced and glasspapered, care being taken not to rub the work down

too deep. A deep crack being wider at the base than at the surface, it follows that the more the crack is rubbed down the wider it will appear. The work should then have a coat of colour mixed in half oil and half turps, with terebene as a drier. This coat should be made up sharp and thin, and well knocked into the cracks; it then forms a key to which the filling can adhere. Next putty-glaze with stiff putty, level with a coat of colour, and again cut down with pumice.

To make a filling for a badly cracked job, take 6 parts of sifted pumice-stone dust with 1 part of lampblack and 2 parts of smudge; mix to a stiff paste with 5 parts of good japan (coach japan is the best) and 1 part of rubbing varnish—that is, hard carriage varnish. Thin to a workable consistency with turpentine, give two coats, and cut down with pumice-stone. For a cheap job some painters take good smudge, mix it stiffly with dried whiting, add japanners' gold-size and hard carriage varnish, with terebene for drier, thin it with turps, and cut it down with pumice-stone when hard.

In a case of partial blistering, the blister may be cut out and the place faced up with hard stopping putty. Powdering is caused by the perishing of the paint material. The perished part may (if not too extensive) be revived by applying a coat of oil colour, or by rubbing with oil in which a little driers has been incorporated. Scaling is due to a similar cause, and the only remedy is burning off. There can be no other cure for scaling, which is the separation of different coats of paint. When a newly painted surface blisters, the blister, being of the same shape as the depression below it, may be pricked, and the skin pressed down to its place. For wood to be filled for varnishing, a transparent mineral is the best base for a filler, with turps to help it to penetrate, varnish being employed to bind the materials together. The surface must be partly filled up with a material so transparent as not to obscure the natural colour and grain of the wood. The filling should be tinted to match the wood; yellow ochre is a good filler for work to be afterwards varnished. Take 1 part of barytes or silex or some fine-grained non-absorbent material, 2 parts of yellow ochre, finely ground, and 1 part of white-lead. Silex is transparent, and white-lead aids in

binding the ingredients together. A filler for wood to be stained and varnished can be made of 1 qt. boiled linseed oil, ½ pt. of japanners' gold-size, 1½ lb. of sifted pumice dust, 4 lb. of whiting, and 2 lb. of plaster-of paris. This can be thinned with turpentine, and colour added. It should be rubbed up stiffly with raw linseed oil to match the wood. Another filler can be made of finely crushed gilders' whiting, levigated, and thoroughly dried, then mixed to a paste with japanners' gold-size. Yet another filler consists of equal quantities of boiled linseed oil, raw oil, enough silicate or whiting to form a paste, and japanners' gold-size to bind; this is thinned with turps. To apply the filler, rub it in with a piece of leather until the wood is full, so as to leave no pinholes, which are caused by the filling not stopping up the pores, so that air bubbles come through. White hard wood must not be primed with linseed oil, which darkens it.

CHAPTER VI.

PAINTING WOODWORK.

In painting new woodwork, resin, knots, dampness, unevenness of surface, and even the marks of the plane may show, as painting or varnishing only helps to bring any unevenness into relief. Therefore, every precaution must be taken to stop out the resin and the knots and to free the work from moisture, dirt, or grease. To make an agreeable finish to the job, old as well as new woodwork requires facing with filling and putty. Too much paint, however, is as bad as too little, and when there is too much paint on the wood, the proper course is to burn it off and repaint.

If the work is in a fairly good condition, the first step is to wash well with water in which has been dissolved a small quantity of soda, varying according to the amount of grease and dirt to be removed. The surface is then rubbed with a soft piece of pumice-stone of such a shape as to accommodate itself readily to irregularities. The painter should do this most thoroughly and carefully, holding the pumice-stone lightly in the hand, and rubbing with a circular motion, not up and down, lest streaks be left in the work. This rubbing removes the hard and more or less greasy surface of the paint. If it is not done thoroughly, failure is likely to result owing to the grease preventing the paint from drying.

The whole of the work, especially the quirks, mouldings, and corners, after being well rinsed and dried, should be finally dusted with a clean cloth. Not a particle of dust must be allowed to remain; specks are apt to be left even after washing, and will afterwards work up in the paint. The soda employed for washing off, if not neutralised by an acid, is liable to come through the paint, even through two or three coats, in a white film. Slightly diluted vinegar in a full coat, well worked into the quirks, will help to prevent this.

In rubbing down after burning off, work with the grain of the wood, not against it.

For stripping paint right off, take 1 lb. of American pearl-ash and 3 lb. of quicklime. Slake the lime in water, add the pearlash, mix to paste, water it down to the consistency of paint, and lay it over the whole work, leaving it for about twelve hours; then scrape off the paint. Or take equal quantities of soda and quicklime ; dissolve the soda in water, then add the quicklime. After this has been applied to the work for a short time, the paint can be scraped off and washed away in warm water.

A surface slightly cracked should be treated with a coat of colour well rubbed in with the pumice-stone, and one that is badly cracked should be washed with turps instead of water, and well scrubbed with a short-haired hog-hairbrush. The use of turps instead of water prevents chance moisture lurking in unobserved cracks. Very badly cracked jobs require filling. Both old and new work are the better for two or three coats of filling.

Where the work is very greasy, do not use clearcole (see p. 77), but go over the spots with strong freshly made limewater; let it dry, then rub it off. If the grease is obstinate, repeat the process until it is entirely removed; afterwards thoroughly wash the lime away and allow the work to get dry before painting. It is imperative that all grease should be removed from any work before attempting to paint it, as grease will prevent paint from ever drying. To old painted work, a good wash is often as good as a coat of paint.

Painting consists, speaking generally, in covering surfaces with a thin coating of lead, stained by mixture with pigments to an agreeable tone. Whatever may be the colour, it should possess pureness, brightness, and depth of tone. White-lead is used for the purpose of supplying body; but there are certain colours which possess body of themselves, without the addition of white-lead. The priming of the woodwork is often done with a mixture of white-lead and red-lead. Some painters have a great fancy for red-lead, and if it were not for the expense would more often use it exclusively for priming. Although red-lead destroys varnish, yet in a general way it forms an excellent priming. Lead being very sensitive, oil turns it brown and

time turns it yellow. Where driers are used, it is best to use such as are akin to the lead, like litharge or sugar of lead.

The purpose for which each coat of paint is applied should be steadily kept in view. The first coat, or priming, is to stop suction, so as to provide a key and a foundation for after coats; the second, to level up all parts of the surface; the third, to give a solid body to the work; the last to impart an even finish.

The priming should be a quick-drying coat of colour, and should form a key for the stopping, which would otherwise be liable to scale off. Priming, by sinking into the wood, helps to fasten the after-coat of paint. It is most important that priming should be a much quicker-drying coat than the last coat; for if the last coat of paint should dry before the under-coat, cracking will be caused, for the under-coat will expand in the endeavour to throw off its moisture, while the coat on the top, being dry, and unable to expand any further, will give way in cracks through the expansion of the under-coat.

It is well to mix some turps with the priming; terebene or patent driers would seem to harden the work too much. Break up the lead in the turps, adding stainers before straining; then add the oil. Red-lead does not require driers, and the less driers used with white-lead or yellow ochre priming the better. The proportion of driers should be about $1\frac{1}{2}$ oz. to 10 lb. of lead, but much depends upon the time of year and upon special circumstances. Strain all carefully through fine wire; wipe off the colour on the strained side of the strainer with a palette-knife—not with the sash-tool with which the colour has been gently forced through. This tool, if so used, should be rinsed out and well wiped on rags before being put in the strained colour.

In painting a door, first do the edge, and then the panels and mouldings, working well into these with a small tool. Allow no fat edges; spread the work so that an equal coat is spread all over. The first coat should have more turpentine than oil in it, so that it may be hard enough to endure the stopping process. If the colour is too oily, it is apt to curl up under the palette-knife. The priming coat, whether prepared wholly with oil or with a large proportion of turps, is always more or less thin,

according to the closeness or openness of the grain of the wood. A very penetrating coat is formed with 3 parts of oil to 1 part of turps. If the first coat is oily, let the second be flattish—that is to say, there should be more oil in one coat, more turps in another. The coats will work and combine better if thus alternated.

The second coat may consist of one-third turps; the third coat, half turps, half oil; the fourth coat, one-third oil, two-thirds turps. When the second coat is dry and hard it should be well rubbed down with glasspaper, and looked over to see whether it requires any further stopping. If the work is very uneven it may require from one to three coats of filling.

The whole of the work should be rubbed smooth, the most particular rubbing being after the second colour.

In laying the different coats, the brush should be held at right angles to the face of the work, so that only the end of the brush touches it. The brush must not be dipped too deeply, and colour should not be allowed to get into the stock of the brush. The colour should be spread evenly over the whole surface, crossed diagonally, and finished with a light touch in an up-and-down direction, always remembering that a brush-mark left even in the first coat will show in the last. The last coat should be rather thin.

For all good work the coats should be well rubbed out; too much paint is an error. The criterion of good painting is not quantity, but levelness and solidity. Thin coats of colour admit of more complete drying and hardening. The third coat, mixed with rather less than half turps and a trifle more than half oil, may be tinted to something like the colour required at the finish, but should be neutral, and slightly darker than the finishing colour.

The flatting, which comes last, is used thin with a full brush, and quickly laid off with a light touch or else stippled. A badger-hair softener produces finer stippling for doors than the ordinary hog-hair stippler. Flatting should be done while the ground is soft (but not wet), so that the flattening may sink into the ground. If the ground colour were allowed to set quite hard the flatting would not sink into the ground sufficiently to bind the colour as it dries; but of course the ground must be hard

enough to resist removal by the flatting. It is best to make the flatting over-night, so that the sharpness of the fresh turps may be modified, as turps always gets sluggish and fat when exposed to the air.

In painting new woodwork, the stopping-out of knots and resinous parts is the first consideration (see p. 70).

With respect to the tone of colour, the first effort is to get a solid colour—to bring up any patchy parts to as nearly as possible the same colour as the rest of the work —and the putty may be coloured in furtherance of this object. The finishing tone of colour should be kept in view all the time.

When the work requires a filling, this is frequently made of a preparation of japanners' gold-size, turps, and yellow ochre. Full information on preparing fillings is given in Chapter V.

The success in getting a good surface is largely dependent on mixing everything properly. The puttying should be done before the priming part has become too hard to lay hold of the putty, which otherwise would not stick to the surface. Well pressed in, the putty is less liable to sink or swell. The common or glaziers' putty as sold in the shops is of no use for this purpose. To make a good putty, follow the directions given on pp. 53 and 73. After the puttying has been rubbed down, the work is ready for another coat, which, when dry, should be well examined to see that no puttying has been missed; it may then be well glasspapered preparatory to the application of the third coat. Glasspaper, producing great results in the hands of the coach painter, is but little used by the house painter. In applying it, care must be taken not to cut through the hard surface of the paint, or the paper will leave a pattern of fine scratches over the surface. Worn glasspaper will give a much smoother surface than new paper.

The workman who, to save labour, will only use paper with a sharp cut, fails to get good results. When the sharp cut has gone, he throws the paper away; whereas paper in this condition is very useful to give a final smooth rub, and will leave the work in prime condition for finishing. Well-papered work always presents a better surface at the finish than work which has not been papered. It levels

the surface, rubs off the dirt, and destroys nibs and any irregularities which, if not papered off, no after-painting will conceal, whilst varnishing only serves to bring them into prominence. On the other hand, the careless glass-papering of woodwork will reduce it to such an unsightly condition that no after-treatment will ever put it right.

An important principle that should govern painting in oil colour is, not to overload the paint; thick paint is very apt to crack.

The flatting ground has a great effect on the after-painting. It is a safe plan to flat on a deep neutral ground, with a pure bright flatting colour. A ground of one colour and a flat of another—say a yellow tone on a green ground—or a neutral colour with a bright flat of another colour, will produce bloom and quality not otherwise obtainable. The flat sinks into the ground-colour and brightens it, while the neutral tone of the ground-colour checks any undue brightness or rawness in the flat.

Blisters on painted woodwork are caused by the presence of moisture of some kind, and may arise from fat under-coats, from painting over a damp surface, or from water in the wood or in the brushes. Resin in the wood is responsible for much of the mischief. Sometimes the blisters may be pricked and the skin pressed back into its place. The only remedy for fat undercoats is to burn them off, though sharp coats of colour will sometimes harden soft undercoats. In the case of damp, the water must first be dried out, and then the blistered surface can be rubbed down with pumice-stone and water. When there is an excess of resin in the wood, the knots should be treated as described on p. 70. In all cases the cause of the blistering should be ascertained and removed before the remedy is applied.

Blisters occur on painted iron when a sufficient quantity of the old coat has not been removed; or they may be occasioned by an excess of oil in the newly applied coat of paint.

When blistering occurs on stucco it may be caused by the lime blowing, in consequence of the newness of the plaster when the paint was applied; or it may arise either from the moisture that has not dried out or from moisture soaking in.

Scaling is caused (1) by lack of cohesion between successive coats of paint, one coat perhaps being too hard before the next is applied; or (2) by two contiguous coats being of such different natures that union is impossible; (3) by using such earthy pigments as have no affinity for iron; (4) by neglecting to remove all scale or rust before painting; and (5), all pigments that are not sufficiently bound together to resist outward influences cause the paint on iron work to decay. Scaling also occurs when old paint is, without any preparation, covered with a coat of new paint. To prevent scaling, the old work should be so treated that the hard and greasy surface is removed, after which sharp and penetrating coats of colour should be given. The remedy for scaling is to burn off and repaint. The application of "sheepskin" will cause scaling.

Powdering is either the result of using bad materials, or is due to some of the causes mentioned above. The remedy in all these cases is to scrape, file, or burn off bad places, then scour with scratch brushes and paraffin oil and reprime and repaint. Another remedy is to rub up the old paint with thin colour, say two-thirds oil and one-third turpentine, so as to give the old stuff new life.

CHAPTER VII.

PAINTING IRONWORK.

Iron is very susceptible to the action of oxygen, or in plain words it soon rusts, and yet, since it is so much used for outside work, it is constantly exposed to the action of damp and changes of temperature. It is a great conductor of heat, and it expands and contracts by the action of heat or cold. When used for the outside of buildings it requires, therefore, to be protected both from oxygen and from damp. The paint applied to it also requires protection from the action of light and from acid vapours. Consequently several qualities are required in paint applied to ironwork. The paint should cling, and not be liable to chip and peel off. It must not carrode of itself, whilst it should be hard enough to resist damp; still it must be elastic enough to withstand the action of different temperatures on the iron, expanding and contracting with it. It must resist water and damp, acids and hard wear. The pigment used must not be capable of affecting the iron itself. The vehicle mixed with the pigment should be able to protect the iron and to resist outside influences—damp and wear, changes of temperature, and deleterious gases.

Paint, if it fails to preserve the ground to which it is applied, may actually help to destroy it; and the paint which is suitable for one ground may be unsatisfactory for another. Frequently a chemical action is set up between pigment and vehicle, or ground and atmosphere. There is no actual chemical affinity between the pigment and the vehicle with which it is mixed, paint being only a mechanical mixture. Chemical action, however, may occur between pigments of opposite characteristics, as when crimson lake is mixed with white-lead; or between pigment and vehicle, as linseed oil and vermilion; or pigment and ground, as emerald green on a lime ground; or

chemical action may be set up in the paint by atmospheric influences.

The oxygen, carbonic acid, nitrogen, and water of the atmosphere will, especially in thickly populated towns, destroy paint even after it has hardened, and in spite of vehicle or varnish. It is necessary, therefore, to select such pigments and vehicles as will most effectually combine for the protection of the surface upon which they are laid. Atmospheric influences are capable of destroying stone, iron, wood, and all such materials. It is naturally impossible, therefore, to find a perfectly indestructible paint; but knowledge of ingredients and materials, of their behaviour in combination, and of their adaptability to certain conditions, should enable the selection of the paint that would prove most durable in given circumstances.

Such colours as indian red, venetian red, and red-lead which have been subjected to the greatest amount of heat in their manufacture—or, in other words, are highly oxidised—are the best for outside work. A red-lead priming, with a finishing colour formed of a pigment mixed with varnish, is the best for ironwork. Red-lead is by far the best possible priming for ironwork. When repainting the ironwork there is no need to attempt to scrape off the red-lead, for it clings to the iron firmly, and does not scale, blister, or powder. It is, therefore, an excellent paint for railings, bridges, glasshouses, and other work that is much exposed to the ravages of our variable climate. Litharge stands next to red-lead, and behaves much in the same way, but it is not so full of body. Neither red-lead nor litharge requires driers; indeed, the painter's only use for litharge is as a drier.

The reason for using red-lead is that it chemically hardens when only the requisite quantity of good oil is mixed with it. It then forms a lead soap, insoluble in water or air, and does not decompose anything it comes in contact with. Red-lead mixed with two-year-old cold-pressed linseed oil, applied directly it is mixed (that is, before saponification has set in), will preserve iron for many years from rust. The first coat of red-lead does not completely fill up the pores; the second coat will do this, besides producing an enamel-like surface.

The next staple colour to these is turkey umber with raw linseed oil—with boiled oil the paint is liable to crack, blister, and peel off; this colour requires driers. For interior work, alizarine, purpurine, bismarck brown, and several of the new permanent aniline colours might be used. Oxide of manganese may be used with the red-lead for a finishing coat; the black of the manganese combined with the red of the lead will form a chocolate; or it may be used with the oxides as a drier, and thus give a select tone of colour too. Vermilion is a colour which withstands heat and moisture. It is a sulphide of mercury, and is not affected by sulphuric acid vapours; and it does not scale or crack, unless the pigment is either mixed with bad oil or is adulterated. It must be painted flat and varnished afterwards, as oil itself does not agree with it. An iron black may be made from ground sulphate of iron. The oxides vary from a deep scarlet to a dark violet.

The above-mentioned pigments give a range of colours which, being of similar nature, will mix without detriment. If a good priming is secured, say of red-lead, a range of permanent colour of the same nature, protected with varnish, will give permanence, and a few brilliant colours will give a decorative effect. Such colours are necessary, for instance, for application to the ornamental ironwork of churches, for the balusters or rails of staircases, etc.

An objection has been raised to the oxides of iron, the opinion being expressed that, rust being an oxide of iron, these colours only serve still further to oxidise the iron. Experience proves, however, that indian red, venetian red, etc., which are made at so high a temperature as to prevent any further oxidisation, stand very well, although they are not so preservative as red-lead, which excels all other pigments for ironwork.

White-lead (basic carbonate of lead) is slightly soluble in water. With the help of carbonic acid in damp places, it sets the iron rusting. Iron has a stronger affinity for oxygen than has white-lead; it decomposes the carbonic acid in it, the iron taking the oxygen, and thus forming rust underneath the paint. White-lead has but little affinity for oil; it is unable to resist the slow action of ammonia and damp. White-lead has a tendency to oxidise

the oil too quickly. The darkening of oil paint is explained by the fact that oil partly takes up oxygen from the pigment, thus burning or charring it.

Zinc white is not suitable for outside work; it is liable to scale, and does not unite well with the oil. It takes up carbonic acid from the air, and soon powders. Zinc white, whenever used, requires more oil or binding than white-lead.

Iron must be thoroughly cleansed before being painted. One plan is to submit it to the action of water containing from 1 to 2 per cent. of sulphuric acid, then rinse with cold water, afterwards scouring with dry sand, and finally brushing the sand thoroughly away. Wire brushes are useful for ironwork. Paraffin oil, well scrubbed in, will cleanse iron. Beat the work with an iron rod so as to detach the loose paint, and use the file and the knife where the paint clings tenaciously. After being scrubbed with a wire brush, galvanised iron should be washed with diluted muriatic acid, the proportions being 5 of acid to 1 of water.

A coat or two of varnish greatly helps to give permanence and lustre to iron. Encaustic varnish is used for inside work; it does not show up the inequalities of the ironwork, and imparts a refined appearance, but is never used for outside ironwork.

When rusted iron is coated with oil paint, it for a time appears as if the rusting process had ceased; but this is by no means the case. Chemical action is set up, forming a monoxide of iron, which has a greater affinity for oleic acid than any other known compound. This unites with the oil-acid in the paint, and thus forms a conductor that enables damp to enter. The corrosion is carried on underneath the paint, which eventually peels off, when the surface underneath is found to be much further rusted than when first the paint was applied. What is wanted for the protection of iron is an elastic paint which will not convey damp or give up oxygen to the iron. The pigments which not only possess these qualities, but are also really decorative, are fewer for iron than for any other surface.

The use of asphaltum and coal tar for painting outdoor ironwork, such as bridges, etc., is open to objection, because these substances have a tendency to melt, and even to run, when exposed to either ordinary heat or the direct

action of the sun. This kind of paint material is liable to gather at the edges. A black paint frequently used for ironwork consists of plumbago and coal tar. Equal parts of asphaltum and resin dissolved in turpentine is also a useful mixture. Jay's metallic paint is made by breaking resin into small pieces and dissolving in turpentine till the compound is of the consistency of treacle. The colouring pigments, such as oxide of zinc, oxide of iron, sulphate of barytes, or red-lead, are then made into a paste with boiled linseed oil and added.

CHAPTER VIII.

PAINTING STUCCO OR PLASTER; DISTEMPERING AND WHITE-WASHING.

Of the several kinds of surfaces to which paint is applied, stucco is that which presents the greatest total area and has engaged the greatest variety of methods. Among the many processes employed—such as oil paint, distemper, fresco, encaustic, water-glass, and tempera—the two now in most general use for the preservation of plaster are oil-painting and distemper.

If lime stucco is used on the outside of buildings, it must be protected by paint. Roman cement is useful for all stucco work, and can be painted. Portland cement is also invaluable for outside work. For inside work, Keene's cement is commonly used. Surfaces originally executed in plasters' putty, and cracked by time and wear, are generally mended with Keene's cement. This excellent plaster is made from gypsum or from plaster-of-paris, which is first steeped in a solution of alum, then calcined, and finally reduced to a powder. As a stucco, it is capable of a high polish. The mineral colours can be mixed with it, if previously rubbed up with water. Imitations of inlaid marble and scagliola can be executed with Keene's cement, coloured. This cement, when used for interiors, should be painted within twelve hours of its application. Parian cement is somewhat similar to Keene's. All these cements are comparatively harmless to lead, but lead has no chemical or mechanical affinity for any of them, and merely clings to the different surfaces by the action of the oil.

New work in plaster or stucco must be thoroughly dry if it has to be painted in oil colour; and it sometimes takes three years (in the case of a new building) for the cement to get thoroughly dry.

In new plaster the free lime always present is very detrimental to paint; but time changes it into carbonate of lime, which is generally inoffensive.

If, however, new plaster be washed with dilute sulphuric acid (the strength of the acid will depend on the amount of heat in the plaster), it will turn the free lime to sulphate of lime, thus accomplishing quickly what time would effect gradually. Time, however, does more than this; it neutralises the lime, with which in plaster a certain amount of clay is present, and in course of time a combination of silica, lime, and alumina is formed, which combination is chemically neutral and inoperative as regards the paint. A process has been patented by which the lime, by treatment with fluoric acid, is converted into felspar, thus forming an insoluble and damp-proof compound.

In stopping up holes in an old ceiling with size and whiting, care must be taken to make allowance for shrinkage in drying. This kind of stopping is very apt to fall out, and in drying will contract to such an extent as to leave cracks round the places mended. Ceilings are far more successfully mended with chalk-lime putty, that being the material of which the ceiling is composed. The putty should be mixed with water only, and not size, except in the case of a coat laid on the surface after the mending to bring it up to the condition of the rest of the surface. Plasterers' putty, with Keene's cement as a drier, might be used.

For mending surfaces preparatory to distempering them, Keene's cement is generally used, mainly because it so soon forms a surface that can be distempered. If the ceiling should be mended with white-lime putty and sand, it would take at least a week to dry, and meanwhile, of course, the work could not proceed. With Keene's cement if the surface behind is dry, or there is open lath-work behind the plaster, the moisture speedily evaporates, leaving the surface ready for the flatting, of which one coat is sufficient. Painting should immediately follow, for if the cement is left for any time exceeding twelve hours the damp returns to the surface and repels the paint. Only one coat of flatting is then necessary. Plaster-of-paris alone is also used. A somewhat skilful hand is needed to spread these quickly drying materials level before they set.

In stopping a ceiling, first wet the hole thoroughly, then

press the plaster well into the hole till it fills up level with the surrounding surface. A large hole will require a part of the old ceiling to be cut away so as to form an edge, bevelled inwards to hold the piece of new plaster in its place. Sometimes the plaster is mixed with warm glue-size, but this cannot be recommended, as it causes unequal suction. Old and cracked ceilings are lined by pasting paper over the entire surface. The ceiling must be quite free from old paint or shellac before it is lined, or the painted paper will come away. The ceiling should be sized, the paper well soaked with paste, and the edges well rubbed, or they will curl after being distempered.

To make a sound job, plastered surfaces—especially cornices—are sometimes given two coats of paint, the first oily, the second flat, to form a ground, which is afterwards distempered; so that when the distemper requires renewing, it is easy to wash it off without damaging the plaster. For securing a similar result with a ceiling, a good plan, when the price will admit, is to put on a double lining by pasting paper in opposite ways and afterwards to paint it. For this purpose lining-paper is used; but cartridge-paper will be found to be better, butting the edges and afterwards rubbing them down with glasspaper. For work intended for decoration it is advisable not to paint the paper, but to clearcole it (see p. 77), and then distemper it in the usual way. Painting prevents absorption; and one of the good qualities of distemper is that, aided by the plaster beneath, it absorbs moisture from the atmosphere and easily dries out again. The stains in an old ceiling may be removed by washing it with vinegar or sulphuric acid. A coat of raw plaster, allowed to dry and then washed off, will remove smoke stains.

Gathering is caused by unequal suction in the work, either from the varying nature of the ground or through insufficient sizing. Size should make up one-fifth of the clearcole. In the case of an old ceiling, if one coat is found insufficient an extra chilled coat may be required. This must be well sized before a coat of distemper is laid. By looking towards the light, a very slight sparkle, appearing over the entire surface, will tell that the work is ready for the final coat. The final coat should contain a suffi-

cient body of colour, should be stiff when set, and be well beaten up in the pail before being applied. In new houses distemper is adopted until the house is dry enough for the walls and ceilings to be painted.

The colours in distemper are rather difficult to fix, and on account of the change which takes place in drying, time is lost in waiting for the tone to develop. It is the common practice to try the colours on a piece of paper first; but in order to see the full effect of a colour it must be tried in its own place. Plaster tends to absorb moisture, but upon paint the moisture goes no further than the surface, and gives but little trouble. In distemper painting there is but a limited range of suitable lime-resisting colours; those outside this range fade and go black, and when ignorantly selected for this class of work set up curious chemical action, causing many a simple piece of distemper to go wrong.

The suitable colours are as follows:—Whiting, naples yellow, yellow ochre, roman ochre, brown ochre, raw sienna, burnt sienna, chinese vermilion, light red, indian red, burnt copperas, terre-verte, cobalt green, raw umber, burnt umber, vandyke brown, cologne earth, ultramarine, cobalt, royal smalt, ivory-black, and charcoal. Zinc white can also be used in distemper. Venetian red is a very useful and permanent colour; indian red should not be mixed with white, but may be modified with chrome. Madder lake works, and will last, upon lime surfaces. Lime-blue is cheap and permanent. Blue verditer is a good blue for artificial light.

The distemper paint-pots should be of earthenware, but either zinc or wooden pails may be used, and the palette-knives may be of wood or of ivory, but not of iron. In mixing white distemper, whiting should be placed in a pail, and just covered with water and allowed to soak for an hour. Then the superfluous water is poured off and hot size added, care having been taken that the size has not been boiled, but merely melted.

In mixing distemper, bare the arms to the elbows, and, plunging them into the pail, break up all the lumps with the hands—for, unlike lead, whiting is non-poisonous. The distemper, when mixed, should always be strained through paper-hangers' canvas. In the mixing a little blue-black

must be added, to prevent the distemper white from changing colour. Any colouring matter mixed with the white should be added before the straining takes place. Double size, or Cannon's concentrated glue-size, is used for distemper. The glue-size should be soaked overnight in water, so that it may be of the consistency of jelly. The size should be put in a clean vessel with some water, to prevent it charring, and melted at a slow fire with frequent stirring.

A little alum added to the colour is very beneficial to the distemper, causing it to lie level. The colours should be well bound with size. When cold, the distemper should be of the consistency of thick paste. Should it then turn out to be too thick, it should be well beaten up with a little water. When the whiting has been reduced to a soft paste, many painters add 2 oz. of alum to an equal quantity of soft soap dissolved in water before the latter is added to the colour. Soft soap, however, is a doubtful benefit, though alum is of decided advantage.

There is considerable difference of opinion as to whether it is better to use melted size or jellied size to mix with the distemper. If the size is moderately hot it mixes thoroughly with the whiting, and if placed in a cool situation will form into a jelly in the course of one night. When the size has been used in the jellied state the distemper can be applied immediately.

Painting out stains in old ceilings with a couple of coats of flatting is seldom effectual, the mended parts showing after the work is finished. This occurs from unequal suction. The distemper coat can be usually applied whilst the alum-size is wet; but, in the case of a very badly stained ceiling, it is best to let the alum-size dry. The stain, having been neutralised, should be touched up with the old distemper that has been washed off. This will give suction sufficient to prevent the painted part showing. When, even after being washed with acid, the stains are too strong, a coat of spirit varnish or knotting should be applied after the wash is quite dry. When the plaster is in the state technically termed hot, the alum-size will cool it. The alum should be melted and put cold to the soaked whiting, and may then be added to the melted size for clearcole.

The plasterer seldom leaves his surface level enough for painting, and paint has a tendency to show up such defects. The necessary filling-up used to be done with distemper made with just enough size to allow of its being rubbed down easily. This was a dirty job, and has for some time been almost entirely discarded, and a filling composed as follows has taken its place:—Equal parts of white-lead and driers, or 2 parts of white-lead and 1 part of driers, combined with 3 parts of japanners' gold-size and turps. This is mixed to the consistency of paint, then sufficient whiting is added to make a paste of it. A slender flexible knife, in skilled hands, can with this filling produce a surface which, when rubbed down, is almost as hard and as smooth as marble.

In preparing a surface of plaster for painting in oil, the stopping is composed of whiting and plaster-of-paris, made into a stiff paste, which, when dry, is rubbed down in the usual way with glasspaper on a square cork.

Distemper does not darken with time, and is easily cleaned with bread.

The two-tied hog-hair brushes are used for large surfaces, a smaller round brush for smaller areas, and sash-tools for cornices. The brushes should never be allowed to get dry with distemper on them. Immediately after use they should be thoroughly washed in warm water, if possible, and the hairs arranged so that they will not dry out of place or be turned.

Distemper is a carbonate of lime, and, provided that the surface upon which it is to be used has been deprived of unequal suction, it will present, in interior work, an even, luminous, and lasting effect. The main reasons for employing it upon ceilings are that distemper produces an effect which is lighter and clearer than that of paint, and can also be easily renewed when discoloured. One of the great faults in the use of distemper consists in "gathering"—that is, from different positions it appears to be of varying texture, and thus looks rather patchy. This effect arises principally from unequal suction. Whilst, however, in some cases the ground should not be altogether non-absorbent, as a certain amount of absorbing quality would give the colour a better chance of clinging, the suction must be even all over. In the case of paint, the upper

coat should lay hold of the coat underneath. With distemper this result is ensured by the moist character of the colour.

Another method of preparing whitewash may here be given. Break four balls of whiting into large pieces, place them in sufficient water to cover them, and allow to stand for a night. Then pour off all the free water, mix the whiting until it assumes the consistency of paste, add about a tablespoonful of dry ultramarine, and stir it well in. Then dissolve 2 lb. of Young's patent size in sufficient water to cover it, in a saucepan over the fire, stirring constantly, and allowing it neither to boil nor to burn. When it is thoroughly dissolved, pour it on the whiting, and mix well. Set the mixture aside until it turns to a jelly, and, with a distemper brush, rub it through a coarse piece of canvas stretched over a pail. Lay it on with a large flat brush, freely, quickly, lightly, moving the brush in all directions, but without splashing. Keep the stuff well stirred in the bucket. Rather more size should be used in summer than in winter; and, if the weather is very warm, it may be necessary to stand the pail in cold water before the size will settle into jelly.

The aim in distempering is to produce a solid dead coating, to ensure which it is necessary that the edge of the work should be kept "alive"; if the ceiling sucks very badly, this will be difficult, if not impossible; so in order to prevent the patchy appearance which would otherwise result, the surface is treated to a preliminary coat of size, termed clearcole, a little whiting being sometimes added. This will stop excessive suction, and give the work a chance to dry evenly.

A superior whitewash for ceilings is made by placing in a bucket or other suitable vessel 1 stone of paris white (best whiting) and 1 lb. of zinc oxide, and making them into a soft paste with water. Melt in another vessel 2 lb. of pale russian glue in $\frac{1}{2}$ gal. of water, and stir this into the paste; then with water thin down 1 oz. of blue, and place in the wash. After being thoroughly mixed, the whitewash is ready for use. The addition of zinc oxide to the wash makes it more expensive, but gives far better results than whiting alone. The wash must not be applied too thick, as this is often the cause of the work rubbing

up and drying patchy. Terre alba is also used for both wash and distemper work; but this is not recommended, as it has very little covering properties, thus making it necessary for the work to be given two coats.

In distempering on wall-paper, first brush the walls down with a hard brush and make good any holes or cracks in the plaster. Melt some ordinary size (half size and half water) and go over the walls carefully, fixing any paper that might be loose or torn. This will stop the suction that the paper naturally has, and will enable any defects to be made good. When dry, the walls might be gone over again with whiting and some of the colour with which the walls are to be finished in the size. The walls are now prepared for finishing. A crushed strawberry colour, if desired, could be made from chinese red, lake, and indian red, mixed with the whiting and size. The distemper will not rub off if there is enough size in it; use about 4 lb. to four balls of whiting.

In preparing a wall for distemper, the best preparation is a thin flat coat of paint. First size the wall with a mixture of soap, alum, and a little glue, tinting the size if dark colours are to be used or if the wall is rough. The distemper itself should be put on in one coat only, as it tends to peel off if thick. The glue should be covered with water, allowed to stand overnight, the non-absorbed water poured off, and the glue melted. The colour is made up to a paste with pigment and fine whiting (or zinc white for very fine work), and is mixed with the glue and applied cool. An absorbent wall requires a large quantity of water. If oil be used, the wall should be primed or sized. The first coat ought to be of white-lead, mixed with plenty of oil, a little japan, and some turpentine. The fourth or last coat should be made flat, well thinned with turpentine, but of the full colour intended. The surface thus produced will bear cleaning with a damp cloth, although it contains little exposed oil.

A wall to be coloured must have a smooth white sand finish, dry and hard, and damp spots should be treated with shellac. For church walls, a rough floated surface is best for distemper. Stippling the wall surface is a method sometimes used for fine work, and is done by treating the walls with the butt of the bristles. A solid effect is ob-

tained by the process if a full coat of colour is given first. For wall colours, greys, greenish greys, or deep reds are suitable. A red, solid but not very deep, toned with yellow and blue, is recommended; a light orange pink is used sparingly; a pale golden tint (yellowish brown), a very difficult colour to match; a pale copper colour between these two; and tints of green, from pure and pale to deepish and grey, always remembering that the purer the paler and the deeper the greyer. Perhaps a terra-cotta red or pink is one of the most useful colours for halls and the dados of dining-rooms and staircases, where there is plenty of light. Tints of grey, from bluish to greenish tones, are suitable, and a salmon colour is effective in a room full of cold light.

A durable whitewash for the walls of a backyard may be made by placing in a tub, or other suitable vessel, a bushel of unslaked lime, and then slaking it with boiling water, placing a lid on the vessel to keep in the steam. Allow the lime to remain for about half an hour, then pass it through a fine sieve or strainer. In another vessel dissolve 8 lb. of glue-size in 2 gal. of boiling water, afterwards stirring in 7 lb. of zinc white in powder. Now add to the slaked lime about 8 gal. of hot water to which has been added 10 lb. of common salt, and stir well together; then add to the lime the size solution, stirring well during the operation. The addition of a small quantity of lime blue will counteract the yellowish tint which so often characterises washes. Before applying the wash, it should be slightly warmed; this helps it to work more freely. It may be applied either with fine or coarse brushes, according to the class of work to be done. It is also very useful for distemper work. If desired, this wash may be prepared without the zinc white, but has not such good covering properties. When the zinc white is added, the work requires only one coat, whilst without the zinc white two coats will be necessary.

To make a drab distemper for basement walls, melt in a suitable vessel 2 lb. of Scotch glue in a quart of water. In another vessel mix 14 lb. of powdered paris white to a thick paste with cold water, and add sufficient dry umber and a little yellow ochre to form a drab of the desired shade. Now stir the glue into the colouring matter and

allow it to cool down, then add sufficient cold water until the required consistency is obtained, when the distemper is ready for use. Another method is to mix together 1 lb. of common dextrin, 2 oz. of alum, 10 lb. of paris white, ½ lb. of dry umber, and 2 oz. of yellow ochre. Pass all through a fine sieve, and mix well together. To prepare for use, add sufficient cold water to form a paste. Both the above recipes are easy to prepare, and will not rub or peel off when dry.

The remainder of this chapter will deal wholly with washable distempers, which are now extensively used. They are most serviceable, perhaps, for colouring the walls and ceilings of new buildings where ordinary materials would not give satisfaction. Suppose, for example, that a new house has to be finished off quickly for occupation, and that the walls and ceilings, though not actually wet, are not thoroughly dry. In such circumstances oil paint cannot be used, for it would afterwards peel off, wall-paper would become discoloured, and ordinary colour-wash would dry patchy. The use of a washable distemper affords the best way out of the difficulty. Choose a wash that does not contain any size, lime, or whiting, but is made from zinc white, is bound with oil or varnish, and has a special liquid sold with it for diluting purposes. Notes on washable distempers are given on pp. 55 to 59.

Washable distempers are sold in every shade and colour, but for new work those colours which do not contain chrome must be chosen, because the lime in the walls affects chromes more decidedly than it affects other pigments. It will be best, therefore, to confine the selection to the greys, buffs, salmons, terra-cottas, browns, and subdued reds.

Assuming that a job is to be done with Duresco (see p. 55), the walls being bare and clean, no washing or other preparation will be required, except that damaged places must be made good with pure plaster-of-paris mixed with equal portions of water and Duresco thinners. Plaster thus mixed will set slowly—that is, in about an hour—but when thoroughly set will be nearly suctionless. All patching of plaster throughout the job should be done as early as possible, in order that it may have an opportunity of drying before the colour-wash is applied.

The ceilings will require two coats, and they should be finished before the walls are begun. The first coat for the ceilings may be white, and should be made of about one-third of the liquid thinners to two-thirds of the body, Duresco distemper, which is generally sold in the form of a stiff paste. It is not practicable, however, to lay down a hard-and-fast rule in this matter; everything depends on whether the plaster to be coated has much suction or not. If, on trial, a sample brushful works out too thin or too stiff, more body colour or more thinners can be added. These distempers require to be used rounder than ordinary colour-wash. A good general rule is to keep them as stiff as they can be worked comfortably.

The more quickly these distempers can be made to dry, the better. It is therefore advisable, in cold and damp weather, to have a fire in the room where they are being used; and at the finish a good draught of air should be allowed to circulate by opening the window or by some other means. In fine, warm weather two or even three coats can be applied in one day, if it is necessary to get the work finished quickly. The ordinary procedure, however, is to allow a day for each coat. The second coat for the ceilings may be white or cream, and must be mixed rounder than the first, using water only, in place of the special liquid—for thinning the body colour—1 part water to 3 parts body colour will generally be about the right proportions for finishing two-coat ceiling work. Any splashes made on other parts of the room should be wiped up before they dry, as afterwards they are very difficult to remove.

The walls may require either two or three coats, according to the condition of the plaster. A little practice with these distempers will enable a man to make a first-class job on fair plaster, with two coats and a touch-up between. On such a wall a good round first coat can be applied. This first coat, when dry, will not be of a uniform colour; some places will have dried lighter or chalky. These light spots generally occur near angle-beads, round fireplaces and door casings, and where the plaster has been patched. All such places should be touched up with a bit of stiff colour of the same tint as that used for first coating, before applying the second coat. When the work is

dry, rub it down with sandpaper. The second and finishing coat for the walls, as for the ceilings, should be mixed with water only, and applied as round as it can be comfortably worked. Some prefer the finishing coat stippled. This finish is in some cases preferable, but is not absolutely necessary.

Where greens or other unsafe colours are selected for new walls, such colours should be used for the finishing coat only; that is to say, the first coat, or, in a three-coat job, the first and second coats, should be safe colours, which, after being applied, should be allowed to harden thoroughly before the unsafe finishing coat is applied. Thus a hard skin separates the lime in the plaster from the chrome or other fugitive stainers in the finishing coats. For a green or blue finish, first coat and touch up with grey of about the same depth. If the finish is of bright red or crimson, the first coats should be made from venetian or indian red and white.

In some cases patches after being touched up still dry chalky. This generally happens when a plasterer, in making good, has used lime with his plaster. In such cases the remedy is to make up a little round flatting colour to match the colour of the first coating distemper. Make this flatting from two-thirds turps and one-third japanners' gold-size, with sufficient white-lead and dry staining colours, and touch up the patches with this.

Where the ceiling, frieze, cornice, etc., of a room are to be finished in different light colours, the whole can be first coated down with white. When several different colours are required in small quantities, it is cheaper and better in every way to get the bulk of the distemper in the white, and small quantities of special pure staining colours separately. These stainers are sold specially by the makers for mixing with the white. With them the painter can himself make any small quantity of any shade or colour he desires, and when the work is finished he will not have a lot of perhaps useless colours left on his hands.

A good washable distemper needs no further preparation, and it is a mistake to use size in any way on work to be painted with it. To keep these distempers in good condition for a length of time, they should be covered with water, and of course protected with a lid to keep out

dirt. Brushes after use should be well rinsed out in warm water.

The total cost of doing a job with washable distemper for the first time is, roughly speaking, about half the cost of oil paint, or nearly double that of ordinary colour-wash. It is when work previously done with them requires redoing that washable distempers show to greatest advantage as regards cost. When a surface has become dirty and requires re-washing, the only preparation needed is simply dusting or rubbing down with damp cloths, the washing and scraping off of old colour-wash (always a costly item) being entirely dispensed with. Old work, however, which previously has been either papered or colour-washed must be thoroughly cleaned by washing and scraping before the washable distemper is applied, or chipping or scaling is likely to ensue. When, as in the case of old limewash, this cleaning cannot be done, remove all loose stuff (a wire scratch brush is sometimes good for this) and apply a first coat of thin sharp colour. This colour can be made from about two-thirds turps, one-third oil and a little japanners' gold-size, with sufficient white-lead and oil stainers and a little patent driers. The distemper can be used on this ground without fear of ultimate flaking.

On a smooth wall, 1 cwt. of unmixed washable distemper will paint about 300 sq. yd. (two coats). In some brickwork or roughcasting, nearly double this quantity of material may be required.

Cement should be left alone until at least five months old. It may then be washed down with dilute vinegar, allowed to stand for a day or two, and then again coated with dilute vinegar. After this treatment it may be coated with the washable distemper.

Painters who propose to make their own washable distempers should be careful to use only the best materials. The following recipe will make a good bodied odourless distemper which, after remaining on the walls from three to four weeks, will not rub up or scale off, and may be painted or varnished upon, if sizing is done before applying the varnish. This preparation may also be used as a priming coat on new wood, especially where cheapness is desired, as it prevents the wood from rapidly absorbing the

oil. Obtain 14 lb. of finest paris white, 5 lb. of zinc white, 1 lb. of gum arabic, 8 oz. of alum, 8 oz. of borax, 1 lb. of glucose, 3 lb. of slaked lime, and ½ pt. of refined linseed oil. Mix the paris white, zinc white, and lime into a thick paste, free from lumps. In another vessel dissolve the gum arabic, alum, and borax with a small quantity of boiling water, then stir well into the zinc white, etc., following with the glucose. The linseed oil is then added and stirred well until thoroughly mixed. The oil may be added just before using, if desired. After the oil has been mixed in, the distemper is ready for use, and may be further made ready by the addition of cold water.

When preparing these distempers for high-class decorations, the ingredients should be ground thoroughly between levigating stones or cone paint mills, but for ordinary purposes may be used without grinding. The above formula makes an excellent white distemper, and cheaper qualities may be prepared by the addition of paris white or whiting. For tinted colours made from the white, lime-resisting colours should always be used, otherwise the distempers when applied turn patchy, and in some cases change colour; for instance, the lime entirely changes green into a light brown colour. These distempers can be rendered valuable as disinfectants by adding oil of tar, carbolic acid, salicylic acid, or oil of cloves.

CHAPTER IX.

COLOUR COMBINATION.

The operative painter who is called upon to beautify a house, the decorator who is required to carry out a scheme of colour merely suggested on a sketch, or the sign-writer who desires to produce a fascia with a telling combination of colours, is frequently at a loss to know how to proceed. The painter perhaps tries at haphazard one or two combinations which may chance to be passable; the decorator may trust to his eye and to past experience; the sign-writer either repeats some familiar combination or hazards an experiment.

A knowledge of the theory of colour harmony, however, would render haphazard experiments unnecessary. But the man who has learnt to work by rule of thumb is inclined to despise theory, because it sometimes apparently runs counter to his own experience, or because, when he has attempted to put into practice what knowledge he possessed of theory, the results may have been of an undesirable character. But the fault is not in the theory, but in the man's superficial knowledge of it, and his consequently incorrect deductions.

As an example of apparent contradiction, the scientist dissecting a ray of light shows it to be composed of seven primary colours (a primary is a colour which cannot be any further split up), which can be again resolved or brought together into a ray of white light; while the man who handles pigments finds only three primaries, from which he can make all compound hues, even black; yet the man of science and the practical man are both right. The mingled rays of colour producing white, and the mixed pigments producing black, severally neutralise each other, the result in both cases being apparently the absence of all colour.

Careful investigation of these and other seemingly irreconcilable facts would be the first step towards a better

understanding of the laws of colour harmony, knowledge which cannot fail to be beneficial to the workman.

It is necessary to remember that there are two sets of theories: those which may be followed in actual work, and those which, whilst true in principle, cannot be readily reduced to practice. For example, though the chromatic circle is used in designing a scheme of colour, and the colour is worked according to the theory of neutralisation, yet the suitability, the situation, and the light the colours will be seen in, are also factors that must be considered. The designer must be guided by the eye, though directed by the mind.

Professors of optics have produced several chromatic circles which differ in detail to a small extent, but the principle is the same in all. In a chromatic circle the colours are arranged to show at a glance the relation of one colour to another, and are so placed that each colour faces its complementary colour—a complementary colour being the primary or secondary that is required to make up the complement of coloured rays to constitute a ray of white light.

In the case of pigments, the complementary colours opposite each other in the circle will produce black, or at least grey; or, in other words, will neutralise each other, more or less, according to the proportionate quantity of the complementary colour used with the principal one. As the complementary pairs face each other in the circle, the principal as well as the minor modifications can be seen. For instance, if red inclined to orange is adopted, the complementary green will incline to blue at the opposite part of the circle; or, if a blue is selected which is inclined to green in hue, its complementary will incline to red. If yellow be tinged with red, the violet or purple tone of its complementary will incline towards blue. The primaries and secondaries only are shown on these circles.

By mixing either of the three primaries in pairs, the compound colours, orange, green, and violet or purple, are produced; by combining them in three, the broken colours, russet, olive green, citrine, all the hues between, and black, may be obtained. Citrine is obtained from a mixture of the three primaries, with yellow in excess; russet is a mixture of the three primaries, with red in excess; olive

is a mixture of the three primaries, with the green in slight excess.

The complementary of any colour is the colour which is in the strongest contrast to it.

White is not altogether a void, although it consists of an apparent absence of colour; white is really composed of all the colours mingled. There are scarcely any purely white objects in nature, the whites being all slightly tinged with one or other of the colours; hence there are cold whites and warm whites. Neither is black altogether negative, since it can be produced by a mixture of the other colours; it may be a brown-black or a blue-black. A tint is a colour with which a proportion of white has been mixed. Luminosity means the brilliancy of a colour.

Neutralisation, which dyers call saddening, is colour going towards shadow, and to a less or greater degree is used in all decorative work, the wall surfaces being always a background. Neutralisation produces what are called æsthetic shades, which harmonise with each other because they are subdued, or saddened, and have one dominant tone. Tertiary colours all approach black or grey; they may be called saddened colours or shadow colours.

Fig. 44 represents an example of the chromatic circle previously mentioned; its inner circle indicates the resultant effects of adding white to the colours named in the outer circle; for instance, white added to scarlet produces buff. In Fig. 45 the inner circle indicates the resultant colours obtained by combining the complementary pairs named at diametrically opposite segments of the outer circle. For example, the mixture of vermilion with emerald green produces sage if the green preponderates, and russet if the vermilion is in excess.

The pigments used by the painter are not direct central colours that can be placed at regular intervals upon the chromatic circle. Vermilion is a yellow tone of red, crimson lake is a blue tone of red, indian red is purple in tone, light red is inclined to yellow, and is neutral in character. The nearest direct yellow is pale chrome. Prussian blue is a greenish tone of blue, and is a good colour for mixing green; ultramarine blue is a red blue, and makes, when mixed with yellow, a low tone of green, on account of the

red in the blue, which neutralises the green. Emerald green is a cold strong green ; cobalt is nearer to green than ultramarine. The ochres, siennas, and browns are all tertiary tints, and do not come within the scope of the

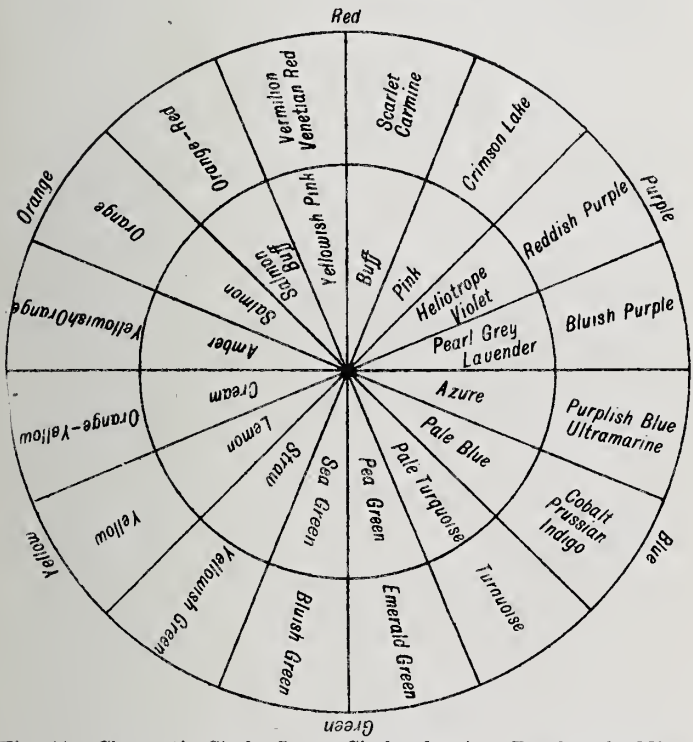


Fig. 44.—Chromatic Circle, Inner Circle showing Results of adding White to Colours in Outer Circle.

chromatic circle. In none of the pigments is there direct central colour, such as exists in the rays of light.

In the finest specimens of ancient colouring, neutralisation was always obtained. It forms the keynote of all colour schemes. If the chromatic circle of the scientist, of the dyer, or of the decorator is examined, it will be found that the complementary pairs in each, if mixed to-

gether, neutralise each other. Neutralisation forms the light and shadow in the colouring of nature, and it is the dominant factor in high art.

The shadow of a colour approaches black—that is, it is partially neutralised. This neutralisation is absolutely necessary in a scheme of colour. The ancients, in using pure pigments, obtained neutralisation by proportioning the ground covered by the several colours, and by the use of compensatory white, gold and black, which check all strong colouring. For outside work, advertisements, fascias, etc., much might be learnt from the brilliant colouring of the ancients. Even with the Egyptians, neutralisation tempered the strong colouring of their walls. The partial rounding of the patterns into the ground, helped by the great shadows thrown by the massive architecture in the flood of sunlight, gave the required neutralisation. The theory of neutralisation is thoroughly understood by the French, who are famous for beautiful refinement of colour. The three primaries, mixed together, enter into nearly every tone in their decorations. The colour, broken with white as well as with the complementary, is thus refined in two ways—that is, towards light and towards shadow. In their schemes of colour, too, there is always a dominant tone; the work may be either warm or cold. In Egyptian work strong colour is compensated for by actual shadow; in French work it is subdued by mixing the tints together.

The pigments of the ancients were never direct central colours, such as are found in rays of light. The reds, browns, and yellows of the Assyrians and Egyptians were inclined to be of a neutral tone. The red of the ancient Japanese was a very yellow tone of red, and their blue was greyish in tone. The Persians used a green blue, with a purple blue as a contrast. The Pompeians used a yellow which was practically an orange tinged with blue; their red can only be imitated by the use of various modern pigments. It may, by varying the proportions of different pigments, be made to harmonise with the colour with which it is in proximity. It is made from a mixture of vermilion, ochre, or raw sienna or burnt sienna, with a small proportion of the umbers. The black of the Pompeians is best imitated by the use of the three

primaries; it can never be matched by the black pigment sold by modern manufacturers.

In devising a scheme of colour for a building or part of a building, several methods may be adopted. A primary may be taken, and used in small quantities with

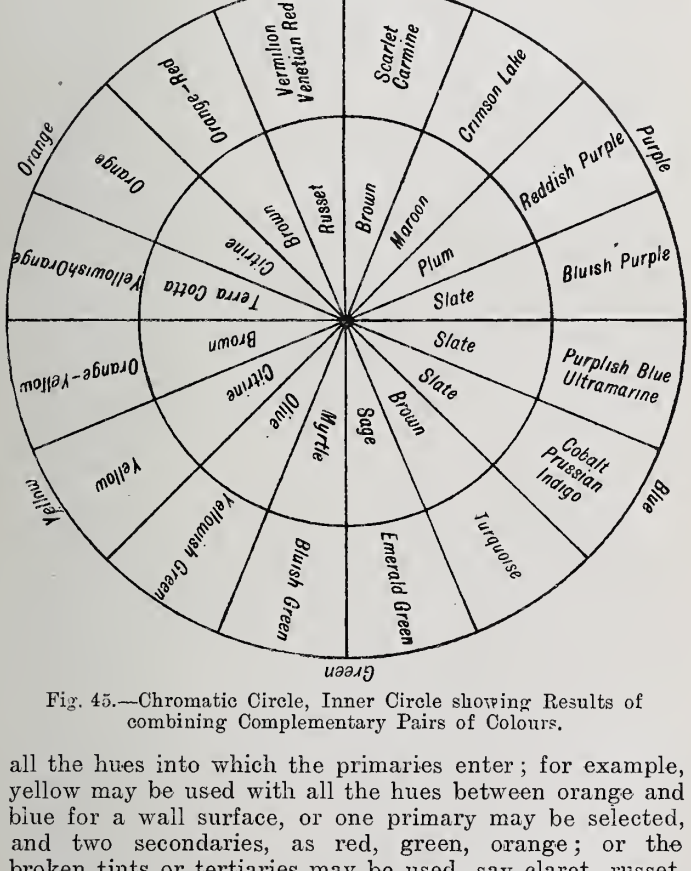


Fig. 45.—Chromatic Circle, Inner Circle showing Results of combining Complementary Pairs of Colours.

all the hues into which the primaries enter; for example, yellow may be used with all the hues between orange and blue for a wall surface, or one primary may be selected, and two secondaries, as red, green, orange; or the broken tints or tertiaries may be used, say claret, russet, and olive green.

In a scheme the colours should, as far as possible, be gently graded one into the other. An alternative is to select one colour for the ground, and use darker or lighter tones of the same colour, with a complementary for contrast; or two warm colours, with one cold colour as a contrast. Colours of the same hue may be altered in value by the addition of white to one of them, or one may be altered by adding to its complementary or contrast colour. There should not be less than 120° between the colours selected from the chromatic circle; the wider apart they are, the better.

Experience shows that a colour may be deepened in appearance by being contrasted with white, or may be lightened by the contiguity of black. Blue makes yellow look brighter and fuller of colour. Yellow causes blue to look purer and less luminous. Blue and yellow stand next to white and black as examples of contrast. Blue on a black ground appears to add orange to the black, thus making the latter less brilliant. As Chevreul says, "each becomes tinged with the complementary of the other." On the other hand, orange on a black ground appears to add blue to the black, so that it appears of a deeper black. When carmine is either mixed with or placed on a black, it becomes purplish in tone. Black placed upon white causes the white to tend towards a bluish grey; whilst upon yellow it appears tinged with olive green.

The luminous colours, as yellow, orange, red, and, generally speaking, the light tones of all colours, are improved by the presence of black; but blue is an exception. White grounds do not suit luminous colours. If white is mixed with a pigment, it weakens its intensity; thus vermilion becomes a pink. It is best, therefore, to lighten it with chrome yellow, as this will not destroy its character. The browns are also deprived of their tone by white. Raw sienna is a useful pigment to prevent chalkiness in a scheme of colour. Generally speaking, black causes colours to look brighter, while white lowers their luminosity.

The effect of colour depends on its situation, the light in which it is seen, and the colours associated with it. In a dimly lighted room, strong pure colours may be used, but the same colours would look bad in a strong light; a

medium light is best for colour. Surface reflection also greatly affects the colour results, a polished or varnished surface differing greatly from a reticulated surface.

A number of contrasts must also be considered. There is contrast of tone, the gradations of a colour towards white and towards black; contrasts of hue, the gradations of one colour towards another colour—say from red to yellow, or red to blue, or blue to yellow; contrasts of texture, where various shades or colours are shown, according to the light that falls on it. For instance, an orange-coloured silk will look yellow in the high lights and brown in the folds; a blue will be violet in the shades, and a green will look blue in the lights; a crimson silk will be scarlet in the lights, and almost a black in the shadows.

Gold appears black or invisible in parts, according to the light in which it is seen. For this reason, gold is generally outlined with black or dark brown. By artificial light, green appears blue; crimson, purple; purple, violet; yellow, white; dark purple, black.

All colours show a different effect when on different planes, and tones of colour obtain their value from their situation, as well as from their contrast with each other. It is advisable, therefore, to try all colours in the positions they are intended to occupy, and in the light in which they are to be seen.

Colours which are incongruous when seen side by side or overlapping, give satisfactory results when separated by a line of white, black, or gold, according to circumstances. These three colours compensate for strong colouring; being themselves neutral their presence helps to give the necessary neutralisation.

When a faulty background prevents ornament from being effective, the ornament should have an edging of another colour, either a band or an outline—the outline serving as a supplementary background to throw up the ornament, when the original background is not strong enough to do this. White, gold, or black—which, as already stated, are neutral and compensatory colours—may form the outline to any colour. Outline is not necessary for ornament on a black or white ground. In self-tints—that is, tones or shadows of the same colour—a light tint on a dark ground may be used; but a darkish ornament

on a light ground calls for an outline of a darker tint than the light one.

The practice of putting a little black or umber with a colour when that colour in its pure state is too bright for its situation is a very crude way of dealing with the difficulty. Suppose, for instance, a wall has to be painted crimson-lake (which, although considered to be a primary colour, is a red inclined to blue). To put black with such a colour because it is too bright in large masses has the effect of making it look dirty, and one might as well buy a cheap, and therefore dull, colour. The proper corrective in this case would be yellow ochre, as the complementary colour to lake, which would lower its tone without destroying its richness. Black may be used in contrast and in company with other colours as a background or as an outline (it makes a fine tertiary green with yellow), but the rule is that over-bright colours should be corrected by their complementaries, and not with black.

In the combination of colours the aim should be to get "colour," not a number of colours set out side by side. The colours must be in harmony with each other, and there must be a relationship between them, or a touch of the same nature in them all. The idea should be to develop the proportions in a room or building, and so to manage its adornment by contrast of tone and depth of colour that the effect of space is produced. This is by no means impossible. If a piece of purple velvet, for instance, were hung at the end of a room, it would appear as if there were a hole in the wall.

It is true that to devise a scheme of colour requires not only inventive skill, but quick perception and ready adaptation. Theory, the chromatic circle, and acquired knowledge are all helpful, but they are helps only. The many examples of colour in flowers, fruits and leaves are full of suggestion. Take, for example, the colours of an apple; there are apples red and apples yellow, the leaves show a variety of green, and there is a touch of the leaf green on the apple as well; these, with the browns and greens of the branches and twigs, readily suggest a scheme of colour. In all red flowers there are as many varieties of the secondary green as there are varieties of the red in the flowers themselves.

As an exercise, the student may set out several circles on a slab, and paint them of any colour produced by the admixture of the three primaries, chrome yellow—or, better still, cadmium—crimson lake, and prussian blue, afterwards giving them proper neutralisation. The practice necessary to produce these spheres will greatly help to a mastery of colour, since it will be found that shading, or saddening, or neutralisation means producing a shadow of the colour itself; and it will be found that a shadow suitable for the yellow sphere will not be suitable for green, and so on. The painted part of the interior of a house is always in the nature of a background; no matter how bright may be the colours selected, they all need neutralising to some extent.

It must be said, however, that inasmuch as the colouring to be applied to a room will often depend to a large extent on the colour of the curtains and of the carpet, not much latitude is given to the painter. The ceiling should contrast with the carpet; the curtains and chair coverings should be met with a contrast on the walls and woodwork. As already said, the aim should be to get colour, not colours, so the contrasts should be in harmony. Rooms with a cold aspect should be warm; in a warm aspect should be cool. Bedrooms should be light, quiet, and cool; dining-rooms rich; drawing-rooms in colours which are cheerful in character and which light up well at night. The staircase should present a comfortable and inviting appearance. If a room is well lighted, the colours must be kept subdued, but when the room is sombre the colours may be brighter and less neutral.

As the wall surface is a background to everything in the room, it should harmonise with everything, and a sympathetic tone should run through all the colours used. If the colour of the furniture is warm, a warm tone should appear in the paper; if cool, a cool tone. If a wall is red, the red should be reproduced in the woodwork, and so on. Even contrasts should be harmonious, and this harmony may be obtained by neutralisation and the use of complementary colours.

Disappointment with the effect of coloured decoration when finished is frequently the result of choosing the tint from sample cards that are really too small to give a good

idea of the general effect except to an experienced person. It is much more satisfactory to paint the tints for approval on pieces of wood (as, for instance, on the short ends of matchboards or floorboards thrown aside as waste by the carpenter), painting only one tint on each piece ; this gives a much better idea of the general effect.

It may save much time, and ensure a good match later, if the exact particulars of the pigments used are noted on each sample ; and, of course, the samples can be preserved for further use.

Another cause of disappointment with the finished tint, when the work is to be varnished, is selecting the colour when painted only. To submit a tint with a brief intimation that it will be slightly darker when varnished is apt to be misleading, and it is therefore advisable to give the sample paint as many coats of varnish as the work is intended to have ; and if the paint is a delicate tint, it is important that the varnish in the sample should be of the same kind and quality as that which is to be used for the work.

CHAPTER X.

HOUSE PAINTING.

The quantity of material required for a job depends, of course, on the amount of work to be done, the extent of surface to be covered, etc. For an average house the following will be necessary: Turps, 5 gal.; white-lead, 6 cwt.; raw linseed oil, 10 gal.; boiled linseed oil, 2 gal.; stainers in oil and water; 12 doz. of the best whiting; patent knotting, 1 gal.; patent driers, 6 lb. Have a knotting pot in each room; when there is only one, a great deal of time will be wasted in searching for it. A good supply of rags is also desirable.

Approximately 1 gal. of paint should cover from 450 to 630 super. ft. of wood, and for a well-painted surface of iron 720 ft. may be covered by 1 gal. of paint. Some pigments cover better than others. Rusty places swallow up paint. Stucco takes more paint than wood.

The proportions for outside work under ordinary conditions, per 100 yd., for four coats, not flatted, are:— Priming: For hard wood, 2 lb. red-lead, 18½ lb. white-lead, 3 pt. raw linseed, 3 pt. boiled linseed, ⅛ lb. driers. Second colour: 15 lb. white-lead, 2 pt. raw linseed oil, 2 pt. boiled oil, ½ pt. of turps, $\frac{1}{10}$ lb. driers. Third coat: 15 lb. white-lead, 2 pt. each raw and boiled oil, 1½ pt. turps, $\frac{1}{18}$ lb. driers. Fourth coat: 15 lb. white-lead, 3 pt. of raw oil, 2½ pt. of boiled oil, $\frac{1}{10}$ lb. driers. For every 100 sq. yd. take 2½ lb. of white-lead and 5 lb. of putty for stopping. Woodwork should not receive less than four coats of paint.

The articles needed are:—Putty, pumice-stone, glass-paper, plaster-of-paris or Keene's cement, a few pounds of soft soap and hard soap; leather, canvas, drop cloths, paint removers, a towel or two; four or five flat brushes, ½ doz. clean pails, 1 doz. clean paint cans or pots, dust brushes, paint brushes, sash-tools, oils, turps, varnish, patent driers, terebene, four planks, four trestles, two step-lad-

ders; kegs of driers (patent); colours in tins (more useful for mixing than dry colours); clean cans and pots (cans which are small at the bottom, though not too small, and which have straight sides, are preferable, as they are so easy to clean down); a sheet of glass or marble to rub colours on; knives, large and small, and various-shaped putty knives; sash-tools of various sizes for mouldings and window sashes; dusters and pound brushes, according to the number of men; a bench, or two pairs of short trestles, should also be taken, with a big board, or some short boards side by side, as there is great comfort in a broad paint bench. The colours in most request are ochre, umber, venetian red, and chrome green.

Plenty of scaffolding should be taken for the job, for a great deal of time is often wasted in running about for a pair of steps or in shifting the scaffold. For a ceiling, trestles perhaps are best, about 7 ft. or 8 ft. apart, with battens from one trestle to another. Battens are better than boards, as they are stouter, and give a hold for the boards to rest on, and the boards should be lined with thinner ones. The scaffold ought not to be taken down till the ceiling and cornice are finished. The scaffold should be about 1 ft. 6 in. from the wall, and about 6 ft. 6 in. from the ceiling, according to the height of the men, who must not be too near to see the effect of the work, nor so far away as to necessitate tiresome reaching. A few boxes on a scaffold are useful for the shorter men to stand on. It is preferable to cover the scaffolding with boards within easy distance of each other. The removing and replacing of boards always involves considerable trouble and loss of time, besides raising dust.

Traps that may cause accidents should be carefully avoided, and the planks should be lashed where any likelihood of a trap presents itself.

The trestles should be carefully examined to ascertain whether the rail is strong enough to hold the weight of the scaffolding. A pair of steps or a ladder placed against the scaffold makes it easy to ascend and descend.

Pots of colour or tools should never be left on scaffold boards or steps.

Any insecurity or oscillation of the scaffold should be immediately reported to the foreman. The scaffold for the

staircase should be built on poles, which adapt themselves to the unevenness of the staircase and make a firm scaffold. A batten nailed crosswise to form a raking stay is most useful in stopping the oscillation of a scaffold. The ladders must be wedged, to prevent slipping. Take care that the ropes are sound on the trestles, and that the stay cords are pulled out to their fullest exent. Do not use ladders or steps which have a missing round, which is sure to be forgotten and thus cause an accident.

Trestles have a tendency to fold unless securely placed at first, and, if necessary, fortified with wedges. It is dangerous to place trestles in two levels—as on a staircase, for instance.

The selection of rope is an important matter, about which a few hints may be useful. A good hemp rope is hard yet pliant, of a yellowish or greenish-grey colour, and has a kind of sheen, silvery or pearly. A dark or blackish colour shows that in the process of curing the hemp has suffered from fermentation. Brown spots indicate that the fibres were wet when the rope was twisted, and that it is therefore weak and soft. Ropes are sometimes made with a core of inferior hemp, covered with good hemp on the outside; this fraud may be detected by cutting up a piece. Others are made with short fibres or of unequal strength, or are unevenly twined; the first fault is disclosed by the woolly appearance of the rope, the ends of the fibre projecting giving this effect. Close examination may disclose other faults that may be disastrous to life or limb.

A room (under lock and key) as near as possible to the work should be set aside to contain material, which no one should touch but the foreman or colourman, and this room should be kept tidy. It may be necessary to have a colour bench in each of the several rooms, if these are large, and if there is a great amount of work to be done. In every case, the colour bench must be placed as near as possible to the actual work. A range of colours should be kept either ready ground on the bench or dry in bottles—not in pieces of paper to be scattered about all over the bench and wasted. Cover the paint bench with lining-paper, which can be frequently renewed and the bench thus kept clean.

Brushes require constant attention. A colourman or boy ought always to be at the colour bench to keep it tidy, to strain colours, attend to the brushes, and clean the pots down every night. Pots should be rinsed out with a little turps and wiped with a rag. All pots and palette knives must be cleaned whilst wet.

All wooden buckets on the job should contain a little water when not in use; otherwise they get too dry, and become liable to split. During frosty weather they should, when not in use, be kept in a cellar to prevent injury from frost.

On beginning the job, the first thing to be done is to protect the place from possible damage by dirt brought in from the street and by dust from the scaffolding. When washing down is being done near a marquetry floor, sawdust may be put down to protect the floor, and changed when it becomes wet from the washing. To protect floors, paste brown paper all over them. Treat the treads of the stairs in the same way. A small piece of thin board nailed to each tread prevents a good deal of damage. A painter should change his boots every time he enters the house, so that the dirt of the street should not be brought in.

If doors can be taken off the hinges, they can then be painted quicker and better, and if they can be carried out into the yard, all damage to the floors by the washing down is avoided.

A systematic method should be adopted. The work should be begun at the top of the house; everything should be made ready beforehand, and the paint bench placed as near as possible to the work. The lime and soda and water should not be allowed to rest on the floor. Cleanliness in this respect is most important, as these substances burn and damage woodwork.

The work in the interior of a house should be begun at the top back bedrooms. Put two men in the top rooms. They should begin at the right-hand corner of the room, the doors and windows to follow the left hand. This plan should be observed all through the house. All waste and dirt must be cleaned away before the painting is begun. The staircase must be left to the last.

In stopping, care must be taken to fill up the cracks

round the doors, window frames, etc. The painted mantelpieces should be washed with strong soda and limewater. Let the strong stuff stand a while on the work to soak in, then wash it off with plenty of water. If the mantelpieces are of marble, lay them in with a paste composed of soda, whiting, and pumice-stone dust. Rub it on with a rag where any bad stains may be. Let the composition remain on the work for a few hours, or till the dirt can be removed. In obstinate cases, lemon-juice, bullock's gall and a little whiting, or spirits of vitriol in bad places, may be used with effect. Afterwards the surfaces can be polished with tripoli, muriatic acid, putty-powder and water, finishing with clean dry rags.

In beginning to paint a room, the ceilings should be first attended to, then the paint. All the washing and stripping should be done first. The wall-paper must be removed, and paint stripped or washed as the case may be, care being taken not to slop the water about. The old paper is removed a small piece at a time and swept to the centre of the room. All old distemper and wall-paper should be cleaned off. The decaying paste of wall-papers frequently harbours the germs of disease; the work should therefore be washed with dilute sulphuric acid. All the woodwork must be thoroughly washed to remove grease, as there is always sufficient on the wood to prevent the paint from drying. To remove the distemper and wall-paper, soak it with a full-haired brush. A worn-out brush or scrub helps to rub off the pieces which stick, and a scraper about 2 in. broad makes it easy to remove the stale paste and old paper from the ceiling and walls. A piece of coarse canvas and a sponge are useful for final cleaning.

The cornice is washed as well as the walls. The quirks should be all cleaned out, and plenty of water should be used in the process, but care must be taken not to scatter it about the place. Plenty of rags and water should be at hand, and extreme tidiness must be observed. Carelessness in painting causes more damage than time and wear, and it is as important to prevent damage as it is to repair it. Washings-off should be cleaned up promptly and continually as the work goes on. In the morning, before beginning to paint, a sweep-out is necessary. Care should

be taken to keep the colour from the sides of the paint pots and kegs, as well as from the heart of the brushes.

Whilst the cornices are free from distemper, the interstices of the ornament should be scraped out with pieces of wood cut to shape, or with a penknife.

The ceiling is now clearcoled and then distempered (see Chapter VIII.). The first coat for the ceiling should be thin and fairly hot; the second is used with the chilled colour, so as to go on thick. Do not lay off the colour as in oil painting, but put it on in short strokes in varying directions, so that the light will not catch the lines made by the brush.

In painting with oil colour, this must be strictly kept from gathering on the edges, or they will become fat. All colour should be well strained. Two things to be carefully guarded against are dust and damp. Warm ventilation should be obtained as far as possible, as it is very favourable for paint. Putty should be of the colour of the ground to be stopped. It should be rubbed with a rag so as to leave no rough edge, and well pressed in to prevent the putty sinking. The rebate and architrave should be painted the same colour as the inside of the room. Before use, a little turps must be added to any colour having a bronze appearance, such as prussian blue.

Mix paint in small quantities at a time, unless a paint mill is in use. It can be mixed or ground up with the palette knife much quicker and better this way than in rubbing up more than the knife can control.

In cleaning paint, strong alkali should be avoided. Whiting is enough for this purpose, or rubbing with pumice-stone. If rubbed with pumice-stone, it will require a coat of paint. A very little soap used with the pumice is helpful. In rubbing with the pumice-stone, care must be taken to avoid taking the paint from off the arris of the door or the edges of the moulding; once off the edges it is extremely difficult to get it on again.

In a house that is to be renovated there are always parts which have sustained much wear, and others which are comparatively fresh. A give-and-take system should be adopted by the foreman in dealing with the work. For instance, in a case of general two-coat work, in some places one coat may be enough, in other places three

coats will be necessary, and the expense would be equal to that for two coats all round. In any case, only two coats should be applied to the rebates of doors.

The duster in all the preparatory processes is very important, for dust, like damp, is an enemy to paint.

In repainting a staircase wall, representing about 120 sq. yd., to a shade of green, if the colour, etc., is procured from a colour merchant (not an oil shop) the quantities and the cost will be as follows:—24 lb. of white-lead, 5s.; 2 lb. of patent driers, 8d.; 1 lb. of deep lemon chrome, 1s.; 3 lb. of deep brunswick, 2s.; 2 oz. of drop-black, 3d., all ground in oil; 3 qt. of linseed oil, 1s. 6d.; and 3 qt. of turpentine, 2s. The white-lead, driers, chrome, black, half the green, and 1 qt. of oil should be mixed well together, after which small quantities of the green should be added until the desired shade is obtained. The paint should be mixed lighter than the sample, as it will dry darker. Divide the mixed colour into two equal parts. Thin one part with the oil so that it works freely, and spread on the wall evenly; twenty-four hours afterwards apply the remaining portion of the colour, thinning with turpentine so that it works freely and covers well. The time is an important item; if the interval is more or less than twenty-four hours the second coat will be sheary—that is, bright in some places and dull in others. If the last coat is stippled the result will be a better job, as stippling takes out the brush marks. Begin at the top and work downwards. There may be a little colour left over.

In a varnished or polished door the rebates should not be polished or varnished, as varnish dries with difficulty in such places. The current of air running through such places stops the drying of varnish. For rebates, quick japan should be used, and the door wedged in till the work dries. If oil colour or varnish be used, it should have driers, as the rebates are so liable to draught and damage. When varnishing is done in the winter, it is often necessary to put driers in the varnish. Stair-rails and balusters always need driers, because of cold draughts.

For external painting, the coats of colour, as a rule, are laid on in a rounder condition than for indoor work. When painting the outside of a house, start at the right-hand corner, cleaning out the spouting. Begin at the

spouting, following the window sashes and panes down the house, and taking doors and shutters in due course. In painting the fronts of houses, the roof has to be made use of for placing the scaffolding. Any damage done must be repaired at the finish of the job, even if a slater has to be called in.

A good wash will sometimes prove as effectual as a coat of paint. In one-coat work, for instance, the backs of shutters may only require washing. Lobbies, cupboards, etc., may be treated similarly.

For repainting a front door, first, if possible, take it off the hinges, and lay it on trestles in a yard. Burn off with a blow-lamp, taking care not to char. A flat chisel knife will take off paint that has been heated through by the lamp. If the work is very old, a coat of turps will help to burn the paint. The surface, after being burnt off, should be well rubbed with glasspaper. If the paint must be removed by means of an alkali, which is not recommended in this case, use equal quantities of quicklime and soda. This mixture having been applied, the work is left to pickle in it for a few hours, when the paint may be scraped off, and the surface afterwards well swilled with water. A soaking coat of vinegar should then be applied to the door.

Before priming, the knots should be either cut out and then filled with putty, or gilded with metal leaf. The priming should be two-thirds turps and one-third oil, mixed thin with white-lead. Then a coat of colour may be followed by two coats of filling, laid on with a chisel knife, and pressed in level. A coat of colour, bound with japanners' gold-size, laid very level, and a flat coat to finish, will leave the door ready for the varnish. The several coats of colour, including the filling, should be graded towards the finishing colour.

Oil and water must be kept away from the work. The brushes must be kept in oil over-night, the oil being well scraped out before use in the morning. In varnishing, the work must be rubbed down with pumice-stone and water between the coats of varnish. If the door is not taken down, the edges, or where the draught catches it, must be varnished with quick-drying japanners', and the door left open till the places are dry. Free use must be made of

pumice-stone and spent glasspaper. The aim from the first is to get a solid colour and a level surface, not to get a lot of colour on the work. Oil is kept out to prevent blistering.

In painting a door, it is best to paint the panels and mouldings first, wiping off the colour from the stiles with a rag so as not to get two coats on the edges. In laying off, begin at the middle upright stile, then proceed to the cross stiles. Finish by squaring off by the two outside rails. The colour must not be allowed to gather on the edges.

In painting a window from a single ladder, avoid shifting more than is absolutely necessary. Set the ladder squarely in the centre, and begin painting the frame from the bottom, transferring the brush from the right hand to the left when convenient. Take one colour from the bottom up to the top, along the top, and down the remaining side.

In painting sashes which have been removed from their frames, set them a convenient height to avoid stooping, letting them lean against a wall. Paint the upward part of the cross pieces, then the vertical part; then reverse the sash, to paint the under side. The face of the sash may be painted last. Where the sash runs into the frames, the colour should be well rubbed out. No paint should be put on the run, and afterwards the sashes should be moved up and down a number of times, the inside beading well wiped with a rag, and all well scraped with a knife before being painted.

New houses built in the autumn should not be painted till the spring. The time to paint the outside of houses is June and July. Time should be allowed for the moisture of the wood to dry out before painting.

To remove the smell of the paint after the work is finished, place a pan of lighted charcoal in the middle of the floor, and throw a few handfuls of juniper berries on it; then close up the room, and render it as nearly as possible air-tight.

The choice of colours for outside work is a subject of much importance, especially with respect to street doors. Although the painter sometimes has the opportunity of advising as to the colour of such doors, it more often hap-

pens that the colour is chosen by the occupier, and green is the favourite colour for this purpose. Now green is very apt to blister, as are most of the dark colours, because of their excessive absorption of heat. Lighter colours have not this disadvantage; yet, strangely enough. black is probably the most durable of all pigments. It may be objected that a front door painted black looks rather funereal, but this appearance may be avoided by painting the mouldings a decorative colour, or gilding them. The reason for this superior permanency of black paint is that the black absorbs more oil than the white.

Pure and brilliant pigments should be used for outside work. The exceptionally strong tinting powers of some of the colours should be taken into account when mixing; for if these strong colours are used too liberally more white is required, and thus too much colour is made up, and is possibly wasted. As instances of tinting power, it may be mentioned that 1 lb. of indian red or chrome yellow will perceptibly tint a ton of white-lead, and that 1 part of prussian blue will similarly affect 5,000 parts of turpentine.

For the finishing coat for outside work turps is either not used at all or used very sparingly—to assist the oil in cold weather, for instance, and to help to harden the paint.

Each successive coat of colour should approach more nearly to the tint of the finishing colour, whether the gradation is from dark to light or from light to dark. Light colours work better over darker colours, although it is popularly supposed that the reverse is the case.

Lampblack, and the oxides of iron, such as venetian red, indian red, and the ochres, are good colours for outside wear, and are better adapted for this purpose than the umbers, but turkey umber and turkey red rank next to yellow ochre and lampblack for outside work in good oil.

For brickwork or stucco, paint is all the better for standing a day or two after it has been mixed. It should contain plenty of oil, and be well rubbed out when applied.

In the case of ready-ground oil colour, beat up the colour in the can, adding small quantities of thinners at a time. No dry colour can be properly mixed by stirring only. It must be rubbed up with the palette

knife or spatula, or ground in a mill. On plaster, two coats of boiled oil make a good preparation for painting.

Stucco, instead of being painted, is sometimes washed down with Portland cement made into a thin paint with plain water, the bad places having been first mended with Portland cement. Sulphate of iron, used in water, gives an effective yellow colour to brickwork that is to be afterwards pointed.

For outside painting generally, two coats of paint are needed, one penetrating, the other round and glossy—the first coat thin and penetrating, to revive the decayed under coat, or to act as priming; the second coat put on thick and rubbed out thin. September, October, and November are considered to be the best months of the year for outdoor painting.

Bad places require two coats of priming, for bricks or stucco. After priming, fill up the bad places with putty. The second coat may be one-third turps, to give penetration. The third coat may consist almost entirely of boiled oil. For a flat finish, another coat, consisting of three-quarters turps, will be required. To destroy the white exudation, caused by alkaline salts, from brickwork, wash it down with acidulated water or vinegar, soaking the surface well. As bricks are very absorbent, it is necessary to ascertain that they are dry before painting them; hence no attempt should be made to paint brickwork during a rainy season or shortly after. Poorly burnt bricks absorb a vast quantity of paint.

In all cases the aim should be to get an equal suction in a ground, as well as a uniform colour. For priming to be effectual, it is necessary to go over the surface with a full brush until the work will not absorb more oil—that is, until all suction is stopped. The paint should be thoroughly rubbed in, and well covered. The painter must never rely on the second coat to make up for the deficiencies of the first.

In many large American cities, such as New York, Philadelphia, and Chicago, it is customary to paint most brickwork as soon as it is built, and afterwards periodically. It is claimed that this treatment greatly increases its durability and improves its appearance. Ordinary bricks, however, like London stocks, are usually too porous to be

painted successfully, but with bricks of closer texture a very neat job may be made by observing the following conditions:—

Choose a time of the year when the brickwork is dry. First thoroughly clean down the surface, using firebrick to rub it with; then apply the first coat of priming, which may consist of old paint ground up with oak varnish, or of oxide of iron paint mixed with boiled linseed oil and a little driers. It is necessary to apply this coat freely, and to brush it well in. After the priming coat is quite dry, the joints and holes in the surface should be filled up with putty, which may be ordinary putty made of whiting and pure linseed oil coloured with venetian red or yellow ochre; but a harder putty is obtained by adding a proportion of white-lead and mixing it well in with the whiting and oil. The paint subsequently applied is either venetian red or yellow ochre, according to the finish required. Every pigment is mixed with linseed oil and a little varnish to assist in binding. As a rule, the best results are obtained by finishing the work without gloss, very little oil being used with the last coat.

The object in painting brickwork is to obtain, by means of the putty and paint, a perfectly level surface without any marks or indications of mortar joints. When it is desired to represent these joints, white lines are painted in by means of little brushes, very similar in appearance to tooth-brushes, called seamers and liners. The seams or horizontal joints are first painted in, usually in white paint, using a straightedge as a guide. The vertical joints are then filled in by hand, marks made on the straightedge indicating the respective widths of headers and stretchers. A typical instance of the value of painting on brickwork is that of an arch that has been set with bad mortar. In such a case repointing would only make the matter worse, as the new pointing soon drops out. The arch, however, if primed, thoroughly well puttied, and then painted and lined in the way described, will present a decent appearance, and retain it for a considerable period.

One of the great troubles which a painter has to encounter is damp, and the only way to conquer this is first to ascertain the cause. Water will find its way through everything, and if stopped one way will find

another. Sometimes it arises from condensation, in which case fires and a system of ventilation are the only preventives; in fact, the cure of chronic dampness in a house necessitates structural alteration. In the case of the inside of a wall which is exposed to rain, or where the subsoil is damp, pitched paper has been tried. The Willesden waterproof paper is also used, but a damp-proof course just above the ground is best. The removal of a course of bricks, and the insertion of damp-proof material in its place, is a permanent remedy.

When dampness occurs from the weather beating against the side of the house, or if the house is built of porous bricks which absorb the rain, cementing the side of the house or slating it has been found a suitable remedy. Most of the mixtures recommended for a wall which is damp from a wet foundation, or from exposure to rain, are at best but temporary. It is certain that whatever is put on the surface of the damp wall only leaves the body of the wall still wet; and as the tendency of all moisture is towards the warmth, any paint on the warm side is sure to blister, decay, and shell off. If the dampness arises from bad spouting, repair the spouting. A trench along the wall, and pipes to carry the water away, will greatly help.

When the water cannot be stopped, convey it away; then thoroughly dry the wall by opening the windows and keeping good fires in the rooms, thus completely drying the damp place; then apply a coat of patent knotting, which will interpose a film of shellac between the wall and the paint. It is a good thing to give the damp place, after the knotting, a coat of bottoms, which is composed of the dregs of varnish and smudge; put it through the mill and well strain it. This is always an excellent priming for any plaster work, besides using up the waste of the paint-shop. If the stucco wall is in good condition, it is frequently painted or distempered after washing with dilute sulphuric acid or vinegar.

CHAPTER XI.

VARNISH AND VARNISHING.

The painter probably has to deal with no material that requires such a large amount of care and skill in its selection and application as varnish, and probably there is none of his materials that the painter knows so little about.

Varnish should be carefully selected for the particular work to which it is to be applied, as it is now made from a great variety of oils and gums, and in various grades, suitable for various kinds and conditions of work.

Oil varnishes are the most durable, especially for exterior work, but they take some little time to dry properly. Spirit and turpentine varnishes are made from the soft gums, and are only fit for interior work, being chiefly used in cabinetmaking and work of a similar character.

Varnishes are made by combining certain oils (or alcohol) with resinous gums, and are used for making pigments hold out to their full brilliance, and also to give a transparent coating of a protective character. The fact that varnish is added over paint to increase its hardness of surface, to hasten its drying, and to increase the lustre of the colour, makes it unnecessary where the pigments have been mixed with good linseed oil, which is in itself of a varnish-like nature; but for marbling, graining, or flat colours, finishing coats of varnish are desirable. Different makes of varnish vary greatly in quality, and it is therefore advisable to obtain or specify that of the best-known makers.

Cheap varnish has usually no durable qualities, and will be found to perish quickly. A kind of white bloom will generally be found on work finished with a cheap varnish. Common varnish also destroys any coat of good varnish that may be put over it; therefore all varnish work done with inferior material should be burnt off (or otherwise effectually removed) before varnish of good quality is applied.

The chief qualities of a good varnish are—(1) rapidity and hardness in drying and freedom from stickiness, even when slightly heated; (2) elasticity when dry, to prevent cracking or curling; (3) durability and (especially for outside work) indifference to the effects of moisture and other atmospheric conditions; (4) tenacity in adhering to the material to which it is applied; (5) ability to present and preserve an even, smooth, and hard surface; (6) good flowing or working properties; (7) good colour, with no tendency to darken on exposure; (8) lustrous, glassy surface, free from tack, and without tendency to bloom.

One method of testing the elasticity of a varnish is to apply two coats of the varnish to a sheet of parchment or linen, and allow it to dry thoroughly, and then try its flexibility, or tendency to chip or curl off, by crumpling the parchment or linen between the hands. The most practical method (if time permits) for testing the durability of outside varnish is to apply two or three coats to a prepared board, and expose it in the open air for several months.

Speaking generally, it is best not to tamper with varnishes by mixing or thinning them, as varnishes from different makers are prepared by different processes or under dissimilar conditions, and are therefore apt to be mutually destructive if mixed together, the lustre and hard-drying properties being lost. Some painters put boiled linseed oil into varnish. Free turps or raw oil should never be added; but whatever is used, the drying properties of the varnish are retarded, and it is also liable to run. Varnish thinned with turpentine dries with an uneven gloss, or altogether without gloss, and is liable to crack. Turpentine also impairs its wearing properties.

The practice of keeping varnish for a time before using does not apply to spirit varnish, which deteriorates if kept very long. Oil varnishes improve with age up to a certain limit on account of a more intimate union taking place between the oil and resins used in its manufacture.

Varnishes usually dry with a high gloss. The oil varnishes dry by oxidation of the oil, and form a transparent elastic skin over the work. Hard varnishes are made for inside work, and elastic varnishes for outside work. Flaking varnishes, encaustic or dead varnishes, or matt var-

nishes, are supplied by some manufacturers for producing dull or lustreless surfaces, but this effect may be produced by mixing varnish with the last coat of paint. Matt varnish may be prepared by adding white wax to copal varnish, and thinning it with turpentine. The degree of deadness is governed by the quantity of wax added.

Gold-size is also used for mixing with turpentine and pigment to produce a quick-drying and dead-surfaced paint, and as a surface for gold-leaf.

Hand-polishing is a term applied to a superior finish sometimes given to first-class work. After the requisite number of coats have been applied, the work is rubbed with the palm of the hand, the ball of the thumb being used for the mouldings. The hand must be frequently passed over a moist washleather to obtain sufficient moisture to allow the hand to be moved lightly but firmly over the work to increase its lustre. The term hand-polishing is also applied to a method of rubbing the work with silk pads, rottenstone, crocus, tripoli, or precipitated chalk, and sweet oil or water, according to the finish, shine, or gloss required.

The conditions necessary to ensure satisfactory work in varnishing are numerous. Cleanliness is of the utmost importance. All floors should be washed and allowed to dry thoroughly before being varnished. Each coat of varnish should be allowed to harden thoroughly. The first coat must stand for a few days to get hard, and may then be rubbed down with spent glasspaper, felt, or pumice-powder and water, till the face of the varnish is deadened. The work is then left for twenty-four hours to get hard before another coat is applied. The work should be kept dry and free from grease, dust, and draughts. A uniform temperature of about 60° F. should be obtained, with a dry atmosphere.

The brush, and the pot containing the varnish, must be perfectly clean. The varnish must be carefully poured out of the side of the can into the pot to avoid air bubbles, and allowed to stand undisturbed in a warm place free from draughts for an hour or so before using. The tips only of the brushes should be dipped into the varnish, which should be laid on freely, with the least possible amount of brushwork ; and, once it is evenly laid, it should

not be retouched. Care must be taken that the varnish does not gather at the quirks and angles.

Varnish may with considerable advantage be kept in a warm place several days before using. The surface to be treated may be gone over with a wet sponge dipped in a solution of fuller's earth—2 oz. of fuller's earth to about 1 qt. of water—and afterwards dried with a washleather before applying the varnish.

Most varnishes deposit sediment or settlings, hence the "bottoms" of a varnish can should not be used for first-class work. Varnish should be stored on a shelf above the ground, in an equable temperature.

Woodwork is sized before varnishing in order to fill up the pores and prevent the varnish from being absorbed into the fibre and producing a dead surface. Concentrated size may be used, as sold at most of the shops which supply painters' materials, or by the firms advertising the article.

Pitchpine is the wood that is most often varnished in its natural state—that is, without being stained or painted. It is usually given two coats of size before varnishing to prevent suction. The number of coats of varnish and the degree of finish are largely governed by the price of the job.

Such woods as oak and teak require a great deal of attention in filling up the pores; they are what are termed hungry woods—that is, coarse and open-grained. The methods adopted for filling-in these woods vary in different localities. In America, patent fillers and shellac are largely used for the purpose. In some districts the filler consists of—(1) whiting and fine pumice-powder, tinted and made into a paste with turps; (2) repeated coats of varnish applied to the work, and each coat cut to a dead level with pumice-powder and water before the next coat is applied; (3) several coats of linseed oil and turps in equal parts; (4) a mixture of boiled oil, finely powdered whiting, and cornflour, mixed into a paste with turps. When fillers are used, a varnish specially made for such work should be used.

Woodwork intended to be varnished requires extra care in its preparation to ensure a smooth surface. The fourth coat of paint should have a hard dull finish. For delicate

tints, pale copal varnish may be applied. After each coat of varnish the work should be felted down with pumice-powder to remove all inequalities. This rubbing down, although expensive, makes the work very durable; but it should not be done on unseasoned woodwork.

Too much red-lead should not be used in the priming of work to be varnished, or it will be found to affect the gloss.

Woodwork intended to be stained and varnished should be prepared very carefully; if glasspapered, only fine glasspaper should be used, and rubbed the way of the grain only. Water stain raises the grain of the wood, while oil stain does not, but the water stain is much clearer than oil stain, and does not hide the grain of the wood. Water stain is best applied before sizing the work, especially if Stephens' stains are used. The size used must be very weak, and must not be allowed to froth or gather at the corners, or it will work up when the water stain is applied. Black beer (porter) used in the place of size gives very good results, but it is desirable to sponge the work over with hot water to raise the grain, and, when thoroughly dry, carefully glasspaper down before the stain is applied. This method gives excellent results.

In preparing the woodwork, glue or other foreign substances should not be allowed to accumulate on the work, or the stain will not take, white patches being the result. In panelled work, the panels, if left "square," should be stained before the work is wedged up; for if shrinkage afterwards occurs white lines will appear. If the work is to be moulded it may be wedged up, cleaned off, and stained, and the mouldings put in afterwards. This prevents any white lines showing should the moulding or panels shrink. All nail holes, etc., in woodwork to be coloured with water stain should be stopped with plaster-of-paris. With oil stain, common putty coloured to match the woodwork may be used. The work may also be sized before it is stained.

In applying the stain, good results have been obtained by first applying it with a brush and then carefully going over it with a soft rag in the form of a large pad, as for french-polishing. Too much should not be done at once before beginning to wipe off, or if a quick drying stain is

used it will be difficult to wipe off and obtain a good effect. The wiping-off method prevents any streaky appearance such as sometimes occurs when the brush alone is used. It also facilitates the obtaining of a uniform colour throughout the work. If the work contains much end grain, it is advisable to size it before staining, as the end grain takes the stain much deeper than the other parts of the work. Water stain should never be used for floors; oil stain applied without the work having been sized is far more durable. A stained and varnished floor does not harbour dust, and is therefore a great advantage from a sanitary point of view.

It sometimes happens that a varnished surface has to be polished. If spirit varnish has been used, this can readily be done, although it is advisable (if the work has been varnished some time) first to wipe the surface over with raw linseed oil, to give a better grip to the polish. In polishing over oil varnish, it is advisable to dull the surface with pumice-powder and apply a coat of glaze before starting to polish.

In painted work intended to be varnished, the finishing coat of colour should be flat. Nothing is more durable than a coat of good varnish. Beautiful effects may often be produced by glazing.

It must not be forgotten that silk, cotton, or oily waste saturated with varnish, turpentine, or oil, are liable to spontaneous combustion.

Varnish has many eccentricities or peculiarities, such as pitting, pinholing, or sissing; cracking, sanding, blooming, blistering, tackiness, flatting, sweating, creeping, flaking, or peeling.

The pitting, pinholing, or sissing of varnish is the formation of little holes in the varnish when applied. It may be caused through (1) damp atmosphere; (2) the presence of turps; (3) the varnish not having settled; (4) contact with ammonia fumes; (5) varnishing over a moist or sweaty surface; (6) an uneven temperature being set up during drying; (7) varnishing over a greasy surface; (8) pouring the varnish out of the can in an improper manner, causing air bubbles in it; (9) tampering with the varnish, as by adding driers, turps, etc.; (10) applying too much varnish and not laying it off properly.

Most of the above peculiarities can be prevented by—(1) cleansing the work with stale ale diluted with water, with diluted vinegar, or with a coat of weak size—the effect of these agents depends on the amount of the deposit and the length of time they have been deposited; (2) damping down the surface with a sponge or chamois leather; (3) obtaining an even temperature whilst applying the varnish; (4) allowing the varnish to settle or stand for an hour or so in a warm place before using, so that the gases in it may escape.

Cracking is generally caused by the superior elasticity of the coat of varnish underneath, or by the paint not being thoroughly dry; by smoke fumes, or by change of temperature. Varnish often cracks on marbled papers through drying too quickly, or not being sufficiently elastic, the nature of the two materials being different. Cracking may be remedied by rubbing down the work and giving it another coat. Varnish is less liable to crack when applied on an under coat of good quality shellac. Dilution with turpentine will also cause varnish to crack.

Sanding occurs in the form of a grainy or spotted appearance, caused by (1) using varnish of a too new manufacture; (2) dust collected by the varnish from the air, as pumice dust, etc.; (3) dirty brushes; (4) change of temperature, or a chill; (5) using varnish which has been stored in imperfectly closed vessels; (6) or by the driers used in the manufacture of the varnish, which may coagulate and form hard particles that become distributed over the work by the brush. Hard particles of varnish may also form in the butt-end of the brush, and these will eventually work down the brush into the work.

Blooming or clouding of varnish occurs in the form of a whitish film, and may be caused by varnishing in a moist atmosphere, by smoke or gas fumes, by a draught, by sudden changes of atmosphere, by varnishing in too low a temperature, or by the surface of the work being colder than the surrounding atmosphere, thus causing the varnish to chill. Blooming is also caused by allowing fog to settle on the work, or the work itself may be damp and dirty. The vapour arising from a damp floor will also cause varnish to bloom. Varnish which has been left uncorked for some time, or which has been stored in a cold damp

place until it has become chilled, will also bloom. To avoid blooming, the work must be freely ventilated (without draught) to hasten the drying as far as possible. Damp will sometimes cause the varnish to turn blue or green.

The bloom may sometimes be removed by rubbing the varnish down with a mixture of oil and vinegar, and thoroughly wiping the surface dry; or the varnish may require to be rubbed down with pumice-powder and revarnished.

Heat causes varnish to become thin, whilst cold will cause it to thicken.

Spots will frequently be found on exterior work after a shower of rain. The evaporation of the moisture by drying causes these spots to disappear. White spots appearing on varnished surfaces may generally be removed by pressing them with a cloth saturated with alcohol.

Blistering of varnish may be caused by undue heat, by the presence of oil or grease under the varnish, by soft under coats, or by moisture in the wood, paint, or varnish.

Varnished work remaining tacky, or not drying, is often due to some defect in the varnish, in which case it is best to remove it and apply a coat of varnish of ascertained good quality. The tackiness, however, may occasionally be due to the work having been washed down with soap instead of soda; or the varnish may have been exposed uncorked for an unreasonable length of time before being applied; or, again, the fault may be due to a dirty brush. A rather expensive remedy is to apply two or three coats of good spirit varnish, or a coat of terebene and one of varnish.

Flatting may be due to soft or absorbent under coats, or to the varnish having been unevenly rubbed out; or it may be caused by mixing two grades of varnish together, by a faulty preparation of the surface, the wood not being thoroughly dry when varnished, or by tampering with the varnish by mixing oil or turpentine with it.

Sweating is generally caused by using fat varnishes (that is, varnishes that have been allowed to thicken in the containing vessel), or varnishing a moist surface; it may usually be prevented by allowing the surface to dry or harden for a few hours before varnishing the work.

Creeping may be the fault of the workman in apply-

ing the varnish; or it may be caused by oily patches on the surface of the work, by touching the work with wet hands, by varnishing in too low a temperature, by using the brush too much, or by the presence of turpentine.

Flaking or peeling may be caused by applying varnish to an unsuitable or damp surface; or by the paint being too thick, or not being quite dry when the varnish is applied.

Finger marks may be removed from varnished work by saturating a piece of chamois leather with sweet oil and applying it gently to the marks. Paint spots may be removed by touching them with kerosene, and afterwards rubbing them with sweet oil.

Dull varnished surfaces may sometimes be brightened by washing them with clean cold water or a mixture of equal parts of vinegar, turpentine, and raw linseed oil, and finally polishing them with a chamois or piece of soft flannel. Another mixture consists of 1 gill of spirits of wine, 1 pt. of raw oil, 1 gill of vinegar, and 1 oz. of butter of antimony. This mixture should be applied very quickly. A vigorous rubbing with leather, however, is a more desirable means of heightening the lustre of varnish than the use of the above mixtures.

Advice on the selection and care of varnish brushes is given in Chapter II., p. 31.

Various mixtures may be used for removing old varnish. The following removers all require to be well washed off with plenty of clean water, and previous to the application of any fresh paint or varnish the work should be brushed over with common malt vinegar, to neutralise any trace of acid that may be left after washing. One composition may be made as follows: 20 lb. of solution of caustic soda of 40 B., 1 lb. of potato starch, and 20 pt. of water are introduced into a closed boiler. The mixture being thoroughly agitated effects spontaneous heating, with conversion into a gelatinous mass. This is treated with $67\frac{3}{4}$ pt. of water and $1\frac{1}{4}$ lb. of potato starch, to form a total weight of 100 lb. of final product. This mixture is reducible by water to any desired percentage of alkali. An emulsion may be formed of 2 parts of ammonia to 1 part of turpentine well mixed together in a suitable vessel.

Another composition consists of freshly slaked hot lime-wash, to each bucketful of which are added 2 lb. or 3 lb. of common washing soda and a pennyworth of rock ammonia. Still another composition consists of $\frac{1}{2}$ lb. of American potash, $\frac{1}{2}$ lb. of soft soap, $\frac{1}{2}$ lb. of rock ammonia, 1 lb. of washing soda, and 1 gal. of water.

In applying these varnish removers, fibre brushes should be used, as the stuff soons rots a brush made of bristles.

Varnish removers containing potash, lime, or soda, if used on hard woods such as mahogany, oak, etc., turn them very dark, but the colour can be restored by frequent applications of oxalic acid diluted with water.

CHAPTER XII.

STAINS AND STAINING.

Staining is the application of colouring without obscuring the grain or texture of the surface to which it is applied. For oil staining the more transparent oil colours, as the siennas, the aniline and cochineal lakes, etc., are used; for varnish staining, varnish is used in addition to the above-mentioned pigments, in order to secure a polished surface. Spirit staining is the use of certain dyes that mix better in spirit than in oil or water. Substances without body and soluble in water—such as gamboge, walnut juice, turmeric, the aniline dyes, etc.—are applied as water stains. Wax stains are a mixture of beeswax and turpentine with pigments like vandyke brown and burnt sienna, the work being polished with a hard brush or coarse jute canvas. Woods should be sized before or after applying the first coat of varnish. Boiled linseed oil applied to wood brings out the lustre and beauty of the grain.

A large number of stains can be used for the decorative colouring of light woods. Stephens' stains are admirable; and to these may be added the numerous aniline stains, which are divided into two classes, the alkaline and the acid—these must not be mixed. As a rule these stains are too bright; the wood dyes are richer and not so gay. The transparent pigments also are useful as wood stains, brunswick black thinned out being sometimes used for this purpose. If laid directly upon the wood, stains are liable to present an uneven appearance; to prevent this, the wood is sometimes sized, or a filler, composed of starch or whiting, or some absorbent material, may be used. As an example, a good oak-coloured filler may be made of finely crushed whiting levigated and dried and coloured with yellow ochre and sienna, mixed to a paste with japanners' gold-size and a little turps, and rubbed into the grain with a rag. When filling is not used, the knots may be treated with size and whiting if for water staining; ordinary putty may be used for spirit stain.

In all staining, care must be taken not to raise the grain of the wood. Glasspaper should be used cautiously, and rubbed the way of the grain; if rubbed across the grain, every mark will show. Nails must be punched down, and the holes filled with whiting putty for water stain, and with oil putty for spirit stain. The stain may be applied fully with brushes, and badgered to make it even, or wiped off the surface with rag. Stains are bright and effective, but are liable to injury; the wood contracts, and in time white lines appear round panels, etc. Stained work does not wear so well as painted work.

Stains are all more or less fugitive. The fashionable green now so prevalent is a copper solution, brown when put on, but afterwards turning green as it becomes oxidised. The colour fades after being exposed to the sun for six months, and leaves a dirty brownish green colour. The same stain applied to furniture seems to stand better, owing its long life to varnish, polish, etc. The grain of the wood should be filled as completely as possible with soft filling (sometimes plaster is used for oak, etc.), and the knots are cut out. If the cracks are large, a piece of the same wood should be inserted.

In proceeding to stain and varnish the deal match-lining of a schoolroom (work which has to withstand a good deal of wear), the nails should be punched in about $\frac{1}{8}$ in. deep and the holes stopped with plaster-of-paris for water stain, and with common putty if oil stain is to be used. The putty should be stained to match the woodwork. If a filler is used, the wood should be rubbed over with linseed oil to bring out the grain and help the filling to cling. Filling is generally used for spirit varnishing; it may be made of whiting dried and levigated, to which a little plaster-of-paris may be added, then mixed with turpentine to the consistency of thick paste. It should be tinted to match the colour of the wood, and be rubbed in with a piece of rag or felt. It should be bound with varnish. Several coats of stain should be applied with a full brush, or be wiped on the surface with rag, being careful to follow the way of the grain. Before varnishing, a couple of coats of size should be applied; this will cause the varnish to bear out well. It is better to rub the work down with coarse canvas rather than with glasspaper.

and it should be rubbed the way of the grain, not across it. Glasspaper, however, is necessary where stopping has been used.

Another method would be to make up the stain with oil to the tint required, well rub it into the fibres of the wood, and wipe dry with a cloth, allowing the stain to go into the wood only; then stop holes with stained white-lead putty, and give the whole a coat of japanners' gold-size, then two coats of good hard church oak varnish. This would stand more wear than size stain with water-size over it. Common water-size has the further disadvantage of getting into the quirks of beads, etc., and making the work look bad.

A new pine dado may be varnished direct on the wood without filling. The knots may require special treatment as already described. When the dado is being sized, a little spirit may be added with good effect. Two coats of varnish may suffice; the first one containing the stain with a little japanners' gold-size, which sets quickly and prevents too great an absorption of the varnish. The border round the floor, after being thoroughly washed or even-planed, may be stained with japan black thinned out with turpentine to the required tone, enough japanners' gold-size being added to bind it—say 1 gill of gold-size to ½ pt. of black made very thin with turps. Finally the floor should be varnished. In dealing with old wooden dado, re-staining would not make a good job. Rub down the bad places, prime, knot, putty, second-colour, and finish as a piece of painted work.

The new floors of a ballroom should be finished with a wax polish. Take ordinary beeswax, finely shred it, and put it in an oven till melted, taking care that it does not catch fire. Then add sufficient turpentine. If the wood of the floor is close-grained, add sufficient turps to make the beeswax thin; if the wood is open-grained, use it in the form of a paste. Then rub it in with a brush or a rag, taking care not to leave any wax on the surface. Afterwards continue the rubbing, first with a coarse material and then with finer, until a good finish is obtained. Hard and prolonged rubbing is necessary.

The hall of a house should not be wax-polished, as damp affects wax-polishing. It would be better to varnish

the floor, applying first two coats of size, one warm, the other jellied, and then a coat of white hard or carriage varnish.

A schoolroom floor might be varnished first with a coat of varnish, to which a quantity of japanners' gold-size has been added (1 gill to ½ pt.); the last coat could be hard oak varnish.

The practice of staining the margin left on the stairs at the side of the carpet and round the outer edge of a room carpeted with an art square has, from a sanitary point of view, much to commend it. A rich brown tone harmonises well with most carpets, but there is no apparent reason why other colours, as mahogany or pine, may not be used. A perfect match is not aimed at, as a good contrast does equally well. To remove any dirt or grease, the floor should be well cleansed with warm water in which has been dissolved a little common washing soda, not soap or powder. When quite dry, the floor is ready for the stain. Permanganate of potash will yield shades varying from light oak to dark walnut. One pennyworth dissolved in 1 qt. of water is about the quantity for a living-room or bedroom of ordinary size. When the stain is too light, apply a second coat or add more potash. A better result is gained by two applications.

Another simple plan is to use an ordinary walnut stain, say vandyke brown, mixed in a rather strong solution of common washing-soda—1 teacupful to 1 gal. of water; apply with a brush and rub well in with a rag, finishing off the long way of the boards. Brush-marks or a patchy appearance are thus avoided.

If mahogany colour is desired, mix burnt sienna—which may be bought at paint stores ground in water—in equal parts of stale beer and water. For pine colour, use raw sienna; common malt vinegar is also useful to mix them with. For a rosewood colour, take 2 oz. extract of logwood, ½ lb. red sanders; boil in 1 gal. of water for an hour. Strain through canvas or muslin, then add alum 1 oz.; apply hot. This imparts a reddish tone. To impart a darker tone, brush over again with logwood stain only; 2 oz. extract to 1 qt. If required still darker, or with dark streaks, add 2 oz. of blue or green copperas to the logwood solution. Floors thus stained should be after-

wards brushed over with glue-size, to prevent the varnish sinking in, and the nail-holes filled up with putty coloured to match ; they should then be given two or three coats of spirit varnish or good-quality oak varnish.

When it is desired to stain and varnish a room in one day a combined stain and varnish is used. Dissolve 4 oz of orange shellac in 1 pt. of methylated spirits ; then add as much dry brown umber or vandyke brown as will give the tone desired in at most two applications ; apply evenly with a large camel-hair brush.

CHAPTER XIII.

ESTIMATING AND MEASURING PAINTERS' WORK.

THE current prices of painters' materials having been ascertained by consulting the manufacturers' price lists, the following data will assist in the production of an accurate estimate for plain painting.

The following are approximately the quantities that, in ordinary circumstances, a painter can do in a day's work of ten hours. They are based on constants of labour, and on information given in various text-books: Of knotting only, 60 to 63 yd. super.; of knotting, priming, and stopping, 38 to 39 yd. super.; of plain painting (first coat after the priming), 70 yd. to 72 yd. super. For the succeeding coats the labour would be practically the same as for the second coat—that is, the coat following the priming.

The labour of cutting in each dozen ordinary sash squares (one side) for each coat would be on the average about half an hour (painter).

The approximate quantity of material required for executing 40 sq. yd. on wood of knotting, priming, and stopping is $\frac{1}{4}$ lb. glue, $\frac{1}{4}$ lb. pumice stone, $\frac{1}{4}$ lb. red-lead, 8 sheets glasspaper, 6 lb. white-lead, $2\frac{1}{4}$ pints of linseed oil, $\frac{1}{4}$ lb. driers, 2 lb. putty. The approximate quantity, in ordinary circumstances, to paint 70 super. yd. (one coat), plain painting, is about $10\frac{1}{2}$ lb. white-lead, $2\frac{1}{2}$ pints linseed oil, 1 pint turps, and $\frac{1}{4}$ lb. driers. There would be but a very trifling difference between the second coat (that is, the coat following the priming coat) and any after coat, probably on 70 yd. only about 1 lb. white-lead and $\frac{1}{2}$ pint of linseed oil less. In arriving at the foregoing quantities, several text-books have been compared, and as regards the quantity of linseed oil and turps required to mix the white-lead, etc. (where especially difference was found), the assumption has been made that 1 gal. of liquid will mix 24 lb. of white-lead; the liquid of course

varying according to the consistency of the paint. Nothing has been included for the powdered or other colouring pigments required to be added to bring the white paint to any desired tint. With common or ordinary coloured paint this is very trifling, an ounce or so of dry pigment being often sufficient for many pounds of the mixed colour. Superior colours—that is, expensive pigments—must be allowed for according to the value of the colouring matter. Such is the variety of pigments on the market, that it is extremely difficult to lay down any hard-and-fast rule as to which are ordinary plain tints and which should be termed superior, or art, tints. If, however, the view be taken that any paint requiring dry colours costing more than sixpence per pound is a superior colour, then the following are some principal pigments that may be classed as superior tints: Drop black, ivory black, chrome yellow, vermilionette, Chinese red, Derby red, Persian red, Turkey red, royal red, Vandyke brown, York brown, carmine, and ultramarine. The following are very expensive pigments:—Royal green, vermilion, King's and Naples yellow, Prussian blue, and Antwerp blue. Many of the lakes cost more than 20s. a pound.

Among the less expensive pigments are: Blue-black and lampblack; all the usual varieties of ochre; Chinese and imperial yellow, Venetian red, Brunswick and lime blues; and Brunswick, Quaker, bronze and emerald greens.

In calculating the cost of painting, allowance should be made for wear and tear in use of brushes, etc. If the work is done from ladders, the labour is probably increased by one-third more than the ordinary work contemplated in the foregoing memoranda. The slight difference in cost of paint mixed with boiled oil for outside work, instead of raw oil for inside work, and the cost of mixing with turps instead of oil where flatting is needed, is very small, and can generally be ignored in estimating.

The exact quantity of paint required for a given surface is not easily estimated, much depending on the volume of the paint, its quality, and its staining properties, and also the manner in which the unpainted surface was prepared before the paint was applied. Plaster and wood, owing to their absorbent nature, require considerably more paint than ironwork; woods with fine or close grain, like

oak, are less absorbent than deal or white wood. The table given below shows the covering properties of various pigments in average circumstances:—

METALWORK.

	First Coat. sq. yd.	*Second Coat sq. yd.*
1 lb. white paint will cover ...	$7\frac{1}{4}$	9
1 lb. red oxide will cover	$9\frac{1}{2}$	12
1 lb. zinc white will cover	12	14

WOODWORK.

	First Coat. sq. yd.	*Second Coat. sq. yd.*
1 lb. red oxide will cover	5	6
1 lb. zinc white will cover	4	5
1 lb. green paint will cover ...	$3\frac{1}{2}$	$4\frac{1}{2}$
1 lb. boiled oil will cover	$4\frac{1}{2}$	6

On plaster 1 lb. of raw oil will cover 5 sq. ft. for first coat and 9 sq. ft. for second coat; 1 lb. of white-lead paint will cover 9 sq. ft. for the first coat. These figures are based on paints mixed to working consistency with raw and boiled oils and from good quality paints.

In estimating the cost of work, factors to be included in the calculation are the time the work is likely to take, the amount of material required, the state in which the job is found, the number of coats of colour.

The four various ways of charging up a job are: (1) By contract (2) for time and material; (3) by measure and valuation; (4) by setting a fair price—that is, a price allowing a reasonable margin for profit after the job is done and all costs have been ascertained.

In writing a specification, or in preparing an estimate for painting a new work, when stating the number of coats it is advisable to express clearly whether or not the priming is intended to be counted as a coat. It is usually, but, as far as the writer's experience goes, not universally so understood. "Five oils on woodwork" is more open to mistake than the full description of "Knot, prime, stop, and four oils."

The correct method of measuring painters' work, such as doors, window frames, etc., is to measure whatever is

painted, allowing all returns, panels, etc., stating the number of coats of paint, the finished tint, and if flatted; also if in two tints. Should the mouldings be cut in, collect them by the foot run; if clearcoled, specify the same; if on new plastered walls, describe the same. All painting should mean and include knotting, stopping, preparing, etc. Narrow widths under 14 in., and having two edges, are cut in and taken by the foot run.

Door Faces (per yard super.).—Take the width of the door, including the architraves and returns, adding $1\frac{1}{2}$ in. for every panel by the height from the floor to the top, inclusive of architrave and any grounds. Collect the length of the jamb linings by the widths, adding rebates and thickness of the door; if both sides of the door are painted alike, double the dimension.

Wainscotings or Panelled Dados (per yard super.).—Multiply the length by the height, and add 1 in. for all panels, etc., in height only.

Window Fronts, Boxing Shutters, etc. (per foot super.).—Take the width, including the returns, dead to the walls by the height from the floor to the top, adding any projection that may occur; take the height of the shutters by the width, adding 2 ft. 6 in. for the edgings inside of the boxings, etc. Collect the whole dimensions of round of elbow caps by 10 in. in width. Calculate the sash squares by the dozen, specifying coats; sashes and frames are numbered, stating how many coats.

Reveals.—Take the heights and soffits by the foot run.

Cornices (per foot run).—Collect the round; if above 14 in. in girth, take them by the foot super.; if under, by the foot run. Particularise if carved or enriched; add one third.

Skirtings (per foot run).—Take the dimensions of the rooms, describing whether square or moulded. Strings of stairs, handrails, newels, balusters, apron linings, and base mouldings are all measured in a similar way.

Rainwater Pipes, etc. (per foot run).—Add up the lengths of rainwater pipes, caves, and gutters, and add 2 ft. 6 in. for cistern heads, and 1 ft. 6 in. for shoes. Say how many brackets.

Ironwork.—Iron, or any other description of railing, is measured as square work. Collect the lengths by the

heights; if painted all round, double the dimension. All bars, brackets, etc., are numbered.

Briefly, it may be said that painting may be measured by taking the quantity from the bills and making an allowance for the edges, or by taking the quantity from the dimensions and allowing for the edges; both ways give the same results. Either method is employed as found convenient. In taking the dimensions of painters' work the line is applied to every part upon which the colour has been laid, and the work is estimated by the square yard; but cornices, skirting, handrails, fascia boards, gutters, rainwater pipes, etc., etc., are taken by the lineal foot.

A paragraph may be devoted to the method of measuring painters' work in the Scottish system. Size tinting, graining and marbling, bronzing, varnishing, and oil painting are taken per square yard, and separated for number of coats, and according as to whether on plaster, wood, or iron, and classified according to style and quality. Railings and gates are taken as flat work twice. The following are all taken per lineal yard: skirtings, belts, mouldings, cornices, pipes, gutters, conductors, and ends of steps, the girths being stated; drawing lines, the widths being stated. The following are numbered: pendants, brackets, pillars, standards (the average lengths being stated), chimney ladders, cistern heads, ears of conductors, outsides of windows and skylights; extra large sizes of the latter are taken per square yard, according to nature and position. Regarding paperhangers' work, in the Scottish system furnishing paper is taken per piece, stating the price, and hanging includes previous sizing. Prices are to include all requisite scaffolding, and washing out floors after the job is finished.

As regards the quantity of paint required to cover a given surface, it may be accepted that 1 lb. of white-lead, properly mixed with oil, will cover about 5 sq. yd. of boards for a first coat, and for a second and third coat the same quantity of paint will cover 3 yd. more.

Suppose it is required to find the cost of painting a door 7 ft. 6 in. by 3 ft. 9 in., on both sides, with three coats, at 1s. per yard superficial:

$$7'\ 6'' \times 3'\ 9'' = 28'\ 1''\ 6''' \times 2 = 56'\ 3'' \div 9 = 6 \text{ yd. } 2 \text{ ft. } 3 \text{ in.}$$

$6\frac{1}{4}$ sq. yd. at 1s. per yard = 6s. 3d.

A room 24 ft. 9 in. long, 17 ft. 3 in. wide, and 11 ft.

6 in. high. What would the painting of the walls cost at 3s. 9d. per square yard?

$$\frac{24'\ 9'' + 17'\ 3'' \times 2 \times 11'\ 6''}{9} = 107\tfrac{1}{3} \text{ sq. yd.}$$

$107\frac{1}{3}$ at £1 per square yard = £107 6s. 8d.

2s. 6d. = $\frac{1}{8}$ of £1 = 107 6 8

13 8 4

1s. 3d. = $\frac{1}{2}$ of 2s. 6d. = 6 14 2

£120 2 6 Cost of painting the room.

Dimensions for Obtaining Quantities for Small Job.

ft.	in.		
4)6	0		
4	0		
		96	Knot, prime, and 3 oils.
2)6	0		
3	6		
		42	Grain and two coats varnish.
20	0		
8	0		
		160	4 oils and flat to plaster terra-cotta.
2)10	0		
2	6		
		50	2 oils to balusters.
8	0		
3	0		
		24	Rub and pumice previous to painting.
10	0		
		10	2 oils cutting for stair carpet.

No. 2 Sash frames 4 oils 6/- × 3/-.
4 Dozen small squares 2 oils.
2 Wood chimney-pieces 4 oils.

ft.	in.		
20	0		
15	0		
		300	Distemper two tints.

In taking out quantities for painters' work a dimension

book is employed, ruled with vertical lines, the dimensions being entered on the left-hand column, and the description of work on the right, leaving the middle column for the squaring figures. On p. 150 the figures to the left of the dimensions and separated therefrom by brackets mean there is that number of similar surfaces; therefore the squaring has to be multiplied by that number.

By way of illustration the quantities for a small job may be taken out. The dimensions are prepared as on p. 150.

An abstract of all the dimensions is now made to prepare for bringing into bill.

ABSTRACT OF DIMENSIONS.

2 *Oils.*	3 *Oils.*	4 *Oils.*	
Super. to baluster.	Super. knotting and priming.	Super. flatting to plaster in terra-cotta.	Super. rubbing and pumiced previous to painting.
9)50	9)96	9)160	9)24
$5\frac{5}{9}$ yd.	$10\frac{6}{9}$ yd.	$17\frac{7}{9}$ yd.	$2\frac{6}{9}$ yd.
4 doz. small sqs.	Super. graining and varnishing.	2 chimney-pieces.	Super. distemper two tints.
Cutting for stair carpet, 10 ft. run.	9)42	2 sash frames 6/- × 3/-.	9)300
	$4\frac{6}{9}$ yd.		$33\frac{3}{9}$ yd

The abstract may now be brought into bill, the pricing of which will enable the amount of the estimate to be arrived at (see next page).

In taking off quantities for varnishing, the work is measured in the same way as for painting. Thus woodwork generally is measured per yd. super. for all work over 12 in. wide. To save time and trouble of measuring the edges, some quantity surveyors usually add one-eighth to the quantity, to allow for the edges and also for panelling. In most cases this will be sufficiently approximate, but small or elaborately moulded panels must be allowed for according to judgment. A description of the varnish should be given, and also the number of coats and finish desired. Staining and varnishing is measured as before described, the number of coats of size, stain, and varnish

Bill of Quantities.

yd.	ft.			Rate	£	s.	d.
5	5	Sup.	2 oils to balusters				
10	6	„	Knotting, priming, and 3 oils on deal				
17	7	„	4 oils and flat to plaster finished terra-cotta				
2	6	„	Rubbing down and pumicing ...				
4	6	„	Graining and 2 coats varnish ...				
	10	run	Cutting for stair carpet and 2 oils				
		No.	2 Wood chimney-pieces, 4 oils				
		„	2 sash frames 6/- × 3/-, 4 oils ...				
		„	4 dozen small squares, 4 oils ...				
33	3	Sup.	Distemper 2 tints				

being stated, and a description given of the colour of the stain and varnish, and it must be stated whether the work is to be finished in more than one tint.

Graining and varnishing is measured by the yd. super., except for handrails, which are taken by the ft. run. The kind of imitation is described, and also the number of coats of varnish.

The price of varnish ranges from 5s. to 30s. per gal.; but, as before stated, the cheaper article is not to be relied upon. Best hard oak varnish for inside work, extra hard church oak varnish, fine hard copal varnish, best hard copal varnish, and best hard carriage varnish, all for inside work, range in price from 10s. 6d. to 20s. per gal.; japan gold-size, 10s. per gal.; extra pale paper varnish, 12s. per gal.

Each coat of spirit varnishing, including sizing (if necessary), is worth from 5d. to 8d. per yd. super. One coat of copal varnish, including sizing (if necessary), is

worth from 6d. to 9d. per yd. super., two coats of copal varnish, 10d. to 1s. Three coats of copal varnish, 1s. 2d. to 1s. 4d., while for each extra coat 3d. per yd. super. may be added. Hand polishing on plain work is worth about 5d. per ft. super. On mouldings or plain columns the cost may be taken from 1s. 2d. to 1s. 3d. per ft. super.

The chief matters to be considered in estimating for and undertaking two typical jobs will now be briefly discussed—the painting, papering, and decorating of a ten-roomed house and a small hotel.

Assuming that the reader is put in charge of the painting, papering, and decorating of a ten-roomed villa of ordinary size, first of all the house should be thoroughly inspected, surfaces measured, and an estimate formed of the labour and material required, as follows:—The surface to be covered should be reduced to square yards, chimney openings being included. Window sashes should be measured up as if plain surfaces, and skirtings under 1 ft. in height as per yd. run. Allow for every 45 yd. of woodwork, 5 lb. of white-lead and 1 qt. of thinnings; for every 12 yd. of ceiling, 3 lb. of size and 10 lb. of whiting; for every $5\frac{1}{2}$ yd. of wall surface, one piece of paper (English), adding one piece to every seven for waste in cutting. Allow six painters and one paperhanger, and one labourer to six men. Place two men in each room. Two step ladders and planks should be provided for each pair of men. As a rough guide, 1 gal. of paint should cover from 450 to 650 super. ft. of wood, or 720 ft. of iron; for stucco more paint and thinnings would be required, according to the amount of suction in the plaster. Before beginning work, everything liable to be damaged should be protected. It is advisable to paste brown paper over the floors, and drop-cloths and thin boards should be laid where there is much wear; thin boards should also be nailed on the treads of the stairs. Fittings should be taken off, tallied, and locked up, and blinds, etc., that would be in the way should be taken down and cleaned. The next step is to clean down and repair. Ceilings should be washed off, paper removed from the walls, paint washed and pumiced down, ceilings clearcoled, bad places mended, chimneys cleaned, and all dirt and refuse swept into the middle of the room and immediately carried out of doors. All the distempering,

washing down, and preparatory coats should be done together in order to avoid a number of mixings. The paint left from one job should, when practicable, be worked up for another, so as to send to the shop as little smudge as possible. Varnishing and paperhanging are the last operations. It is highly important that forethought should be exercised to get all surfaces and all materials ready in advance of the workmen, so that the different stages of the work may follow each other smoothly and without delay. Begin work at the top left-hand room, and work to the right, leaving the wet work on the left hand. In painting the outside of the house, begin at the top left-hand corner and work downwards, taking windows and doors with the rest of the work. Plenty of scaffolding should be provided, the pots kept clean, cleanliness observed in wiping down, care exercised in keeping the brushes and in the use of materials, and economy studied by using up colour, saving only enough for finally touching up.

Placed in charge of a ten-roomed villa to paint, paper, and decorate, an old hand would estimate by experience rather than by rule. If the wall is damp or damaged, mere measurement is an insufficient basis for an estimate. It is not so much the size of the wall or ceiling as the condition they are in that affects the price.

Say that a small hotel, consisting of about thirty rooms, is to be thoroughly redecorated and painted inside and out. The hotel is to be occupied during the progress of the work, the rooms being given over to the painters a few at a time. Naturally, the work must be finished expeditiously. Measure the work and estimate the quantities of materials required as before.

Two men might be put in the small rooms, and three in the larger, with a labourer (to fetch water, etc.), and a boy at the paint bench. Remove all the fittings and removable fixtures, take down the blinds, affix a descriptive tally to each, and lock all in a cupboard. The floors should have brown paper pasted over them on which to lay drop cloths. Thin boards or strips of linoleum should be laid on the stairs. Two step ladders, a plank, and a kit of brushes should be supplied to each pair of men. Other requirements for the job are:—A wide paint bench on trestles; half a dozen distemper brushes; three leathers;

half a dozen sponges; two dozen galvanised iron kettles; one dozen earthenware pots; canvas; fine and coarse strainers; pasteboard and trestles; half a dozen dust sheets; one dozen fitches; and one pair of large stipplers; adding to the plant as occasion requires. Wash the ceiling, burn off the paint, and strip the walls. Begin working at the top rooms at the right-hand corner, the doors and windows to follow the left hand. The staircase is done last. If the mantels are to be painted, give them, after washing, a coat of paste driers thinned with turps. Finish all the ceilings first, and clear away all the rubbish. Insist that every workman wears slippers, so as not to carry dirt in from the street. Arrange that the coats of colour shall follow each other in such order that the paint in one room may be getting hard whilst the work in another room is in progress. The planks and ladders should be well washed before being brought on the job.

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